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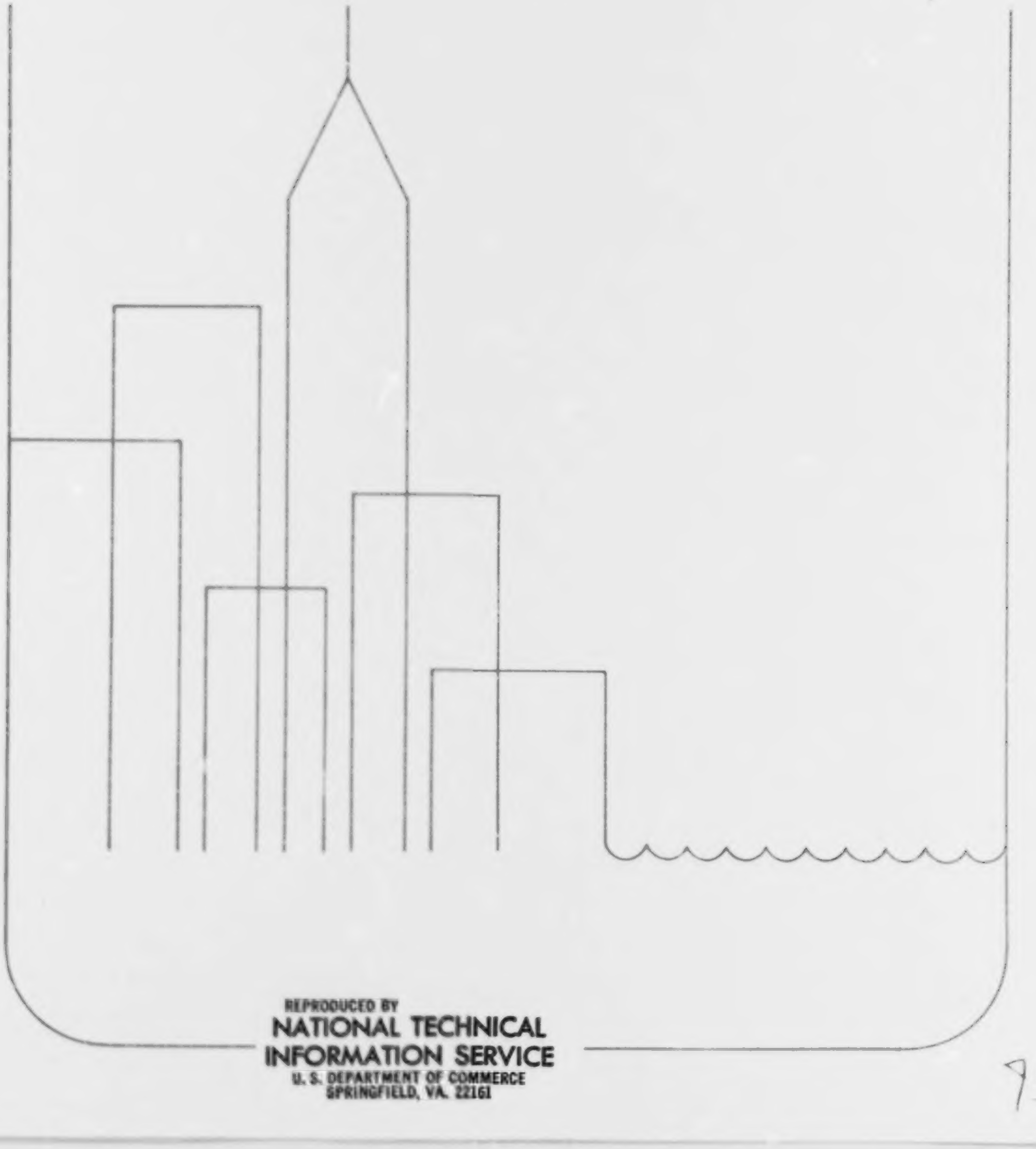

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The Franklin Institute Research Laboratories, Science Information Services Organization, prepared for the Environmental Protection Agency Volume 5 of the *Municipal Technology Bulletin*, a current-awareness abstracting bulletin covering methods of municipal waste water treatment, problems of water quality, and water pollution control. Volume 5 of the *Bulletin* contained abstracts of technologically significant literature appearing in print during 1977 and 1978. Under the same grant the Science Information Services Organization, as a center of competence on municipal waste water, provided 1320 abstracts, including those appearing in the *Bulletin*, to the Water Resources Scientific Information Center (WRSIC). The *Municipal Technology Bulletin* informs researchers, consultants, engineers, and government officials of current developments described in more than 4000 English and non-English language scientific and technical publications. Topics covered in the *Bulletin* and in the abstracts submitted to WRSIC include: analytical techniques for water quality measurements; biological, chemical, and physical methods of waste water treatment, disposal, and recycling; construction and equipment for pollution control; model studies; storm runoff; tunneling technology and sewer systems; and treatment plant operation and automation. This report is a compilation of the 1320 abstracts arranged consecutively by accession number within subject categories. The report is completed by a journal list and subject and author indices.

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MUNICIPAL WATER POLLUTION CONTROL
ABSTRACTS
November 1977 - October 1978

by

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Grant No. R804922-01-2

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ABSTRACT

The Franklin Institute Research Laboratories, Science Information Services Organization, prepared for the Environmental Protection Agency Volume 5 of the *Municipal Technology Bulletin,* a current awareness abstracting bulletin covering methods of municipal waste water treatment, problems of water quality, and water pollution control. Volume 5 of the *Bulletin* contained abstracts of technologically significant literature appearing in print during 1977 and 1978. Under the same grant the Science Information Services Organization, as a center of competence on municipal waste water, provided 1320 abstracts, including those appearing in the *Bulletin,* to the Water Resources Scientific Information Center (WRSIC). The *Municipal Technology Bulletin* informs researchers, consultants, engineers, and government officials of current developments described in more than 4000 English and non-English language scientific and technical publications. Topics covered in the *Bulletin* and in the abstracts submitted to WRSIC include: analytical techniques for water quality measurements; biological, chemical, and physical methods of waste water treatment, disposal, and recycling; construction and equipment for pollution control; mathematical, statistical, and simulation model studies; storm runoff; tunnelling technology and sewer systems; and treatment plant operation and automation. This report is a compilation of the 1320 abstracts arranged consecutively by accession number within subject categories. A list is provided of the abstracts that appeared in the *Municipal Technology Bulletin.* The report is completed by a journal list and subject and author indices.

Municipal Water Pollution Control Abstracts: November 1977-October 1978 is submitted in fulfillment of grant number R804922-01-2 by the Franklin Institute Research Laboratories under the sponsorship of the Environmental Protection Agency. Work on this project was completed as of October 31, 1978.

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INTRODUCTION

For the purpose of providing ready access to the large body of current literature on municipal waste water collection, treatment, and disposal, the Science Information Services Organization of the Franklin Institute Research Laboratories has abstracted, categorized, and indexed pertinent literature appearing in print during 1977 and 1978. This service was made possible through a grant from the Environmental Protection Agency's Office of Research and Development. Abstracts of technologically significant articles were printed in Volume 5 of the *Municipal Technology Bulletin*, a monthly current awareness abstracting publication. A total of 1320 abstracts, including the 304 appearing in Volume 5, were submitted to the Water Resources Scientific Information Center (WRSIC), Office of Water Research and Technology, Department of the Interior. The present report is a compilation of these 1320 abstracts and serves as a specialized yearly bibliography on municipal waste water control.

The *Municipal Technology Bulletin*, Volume 5, is the outgrowth of several preceding publications which were prepared by the Franklin Institute for the EPA: *Selected Storm Water Runoff Abstracts*, 1970-1972, and the *Municipal Technology Bulletin*, Volumes 1, 2, 3, and 4, 1973 to 1977. These publications were designed to meet the information needs of officials, researchers, and engineers regarding recent developments in the field while allowing them to spend a minimum amount of time in personally scanning the literature. The abstracts in the *Municipal Technology Bulletin* provide a basis for further exploration of the relevant water resources literature.

Material for the *Municipal Technology Bulletin* was selected by the regular scanning of over 4000 English and non-English language publications, including technical journals, government reports, industrial reports, newsletters, patent gazettes, design manuals, conference proceedings, recent dissertations, and textbooks. The material was screened at the Franklin Institute Library and several other Philadelphia libraries. Additional screening was performed at the Franklin Institute's facilities in Munich, Germany, and Tokyo, Japan. Each month, 25 to 30 documents pertaining to the latest waste water technology were selected for inclusion in the *Municipal Technology Bulletin*. Specific subjects covered were: (1) waste water treatment methods relating to facilities, land application, utilization of sludge, waste water reuse, legislation, plant automation, and mechanical and chemical devices; (2) sampling and instrumentation for biological, chemical, and physical analytical techniques; (3) storm water runoff, including urban runoff, runoff forecasting, flood routing, rainfall-runoff relationships, catchment basins, and surface runoff; (4) tunneling technology and sewer systems, including combined, separated, outfall and interceptor sewers, storm drains, infiltration-inflow, materials, and equipment; (5) patents for methods and equipment pertaining to waste water treatment, reuse, and disposal; (6) mathematical, statistical, and simulation model studies; and (7) hydrologic aspects involving parametric hydrology, sewer hydraulics, and drainage.

In 1977 and 1978, the *Municipal Technology Bulletin* was distributed free of charge on a monthly basis to 720 selected recipients whose names were supplied by the EPA Project Officer, or were added to the mailing list as a result of their direct request to the Franklin Institute.

Through this EPA grant, the Franklin Institute served as a center of competence for municipal waste water pollution control. Thirteen hundred and twenty abstracts on municipal waste water treatment methods were provided to WRSIC. These were published in *Selected Water Resources Abstracts,* WRSIC's semi-monthly abstracting journal. They were also entered into the WRSIC computerized data base. Literature was chosen for input to WRSIC using essentially the same criteria and screening procedures as for the *Municipal Technology Bulletin*.

This report includes all the abstracts prepared for the *Municipal Technology Bulletin* and WRSIC. So that this publication may be easily used as a specialized bibliography, an in-depth subject index is provided in a hierarchical, computer-generated form. A complete author index and a journal list complement the subject index. The abstracts are ordered by consecutive accession number within each subject area. Topic headings are: Storm Runoff, Sewer Systems, Patents, Treatment Methods, Analytical Techniques, Model Studies, Hydrologic Aspects, and Miscellaneous. The format of each abstract is displayed on the following page.

ABSTRACT FORMAT

FIRL ACCESSION NUMBER

TITLE OF ARTICLE

NAME OF AUTHOR(S)

AFFILIATION OF PRIMARY AUTHOR

BIBLIOGRAPHIC DATA: Journal Title (source), Volume, Issue number, Pagination, Data, Figures, Tables, References.

ABSTRACT

MUNICIPAL TECHNOLOGY BULLETIN ABSTRACT LIST

ACCESSION NUMBERS

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MUNICIPAL WATER POLLUTION CONTROL ABSTRACTS

STORM RUNOFF

A001
SIMULATION OF NUTRIENT LOADINGS IN SURFACE RUNOFF WITH THE NPS MODEL,

Donigian, A. S., Jr., and Crawford, N. H.

Hydrocomp, Incorporated,
Palo Alto, California.

1977. 110 p, 30 fig, 8 tab, 24 ref, 3 append. Technical Report EPA-600/3-77-065.

The Nonpoint Source Pollutant Loading (NPS) Model was evaluated for simulation of nutrient loading in surface runoff with one urban and two small agricultural watersheds. The NPS model was used to simulate total solids, total Kjeldahl nitrogen, total phosphorus, and iron for storm runoff over an 18-month period. Phosphorus, total nitrogen, and iron values predicted by the model compared favorably with observed values. Other parameters such as ammonia nitrogen, nitrate nitrogen, and phosphate phosphorus, which are transported in solution rather than in the sediment fraction of surface runoff, were not predicted as accurately. The NPS model is suggested as an adequate means of simulating nutrient loadings on the basis of sediment loss. Application of the model may be limited if subsurface flow in the area being considered is a major portion of total runoff.

A002
ECONOMIC OPTIMIZATION OF RELIEF SEWER DESIGN,

Graham, S.

Florida University, Gainesville,
Department of Civil Engineering.

Water and Pollution Control, Vol. 115, No. 9, p 27-28, September, 1977. 1 fig, 7 ref.

While sewer design capacities must be adequate to handle the expansion of urban areas, designs to accomodate the largest, most intense storms may be prohibitively expensive. A "rational formula" is often used to compute the maximum discharge for an arbitrary design storm, but the method may have several drawbacks. In-system storage and surcharge can not be predicted because pipes have free surface flow. Water quality and flows in pipe networks without steady, uniform conditions can not be measured. Problems with flooding or surcharging are normally solved with pipe enlargement or twinning, although these procedures are not necessarily cost-effective. Various storm

A005
INNOVATIVE SOLUTION TO STORM WATER MANAGEMENT PROBLEM,

Public Works, Vol. 108, No. 9, p 144, September, 1977.

Storm water detention facilities were required when the Alexandria Hospital in Virginia decided to expand its parking facilities. VVKR Partnership, an Alexandria firm of architects and engineers, was commissioned to find a solution. The calculated required storage capacity necessary for the 5-acre site was 6,000 cu ft at a 10-yr rainfall intensity and a release rate of 6.4 cfs. Since detention in surface ponds, oversized pipes, concrete chambers, or gravel interceptors was not considered feasible for the site because of problems in construction and maintenance, VVKR investigated the possibility of an underground fiberglass storage tank. Owens-Corning Fiberglass fabricated the 75-ft long, 10-ft diameter tank. The tank, which was shipped in two sections, has a weir-containing junction box at one end to permit the desired release rate of detained storm water. Use of the fiberglass tank resulted in savings in cost and construction time.

A006
INTERACTION OF URBAN STORMWATER RUNOFF, CONTROL MEASURES AND RECEIVING WATER RESPONSE,

Medina, M. A., Jr.

Dissertation Abstracts International B, Vol. 38, No. 2, p 861, August, 1977.

Mathematical models for the movement, decay, storage, and treatment of storm water runoff pollutants and dry weather waste water flows through the urban environment and receiving waters are presented. Autocorrelation analysis is used to stochastically characterize the precipitation time and urban runoff series produced by a continuous hydrologic simulation model. Minimum dissolved oxygen concentration curves are used to illustrate the effects of waste input from wet and dry weather sources and from points upstream on receiving waters. Frequency distributions are analyzed for input and output concentrations and mass rates during single storm events and storm events recorded during a year-long period. Flow and concentration responses of storage/treatment systems are examined for completely-mixed systems with constant and variable volumes, and for one-dimensional advective systems with and without dispersion. Detention time was found to have the greatest influence on the effect of urban runoff on receiving waters.

A007
UNDERGROUND TANK USED FOR STORM WATER DETENTION,

Water and Wastes Engineering, Vol. 14, No. 9, p 59, September, 1977.

An underground fiberglass storage tank was chosen by VVKR Partnership as a solution to storm water detention needs at the Alexandria Hospital in

Virginia. City ordinances and existing storm water runoff problems required the construction of storm water detention facilities when Alexandria Hospital constructed additional parking facilities. The required storage volume for the 5-acre site was estimated at 6,000 cu ft of water for a 10-yr rainfall intensity and a release rate of 6.4 cu ft per second. Conventional methods of storm water detention such as surface storage ponds, below-grade storage in concrete chambers, oversized pipes, and gravel interceptors were rejected because of costs, maintenance requirements, and specific problems related to the site. Manufactured by Owens-Corning Fiberglass, the 75-ft long, 10-ft dia tank was shipped in two sections and was equipped with a special junction box to control the release rate.

A008
WATER REUSE,

Chaturvedi, A. C.

Irrigation Commission,
Lucknow, Uttar Pradesh, India.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 108-111, June, 1977.

Because water supplies in Uttar Pradesh, India, are limited and often contaminated, reuse of waste water, although an expensive process, becomes attractive because of the gain in water resources. The waste water treatment plant plans to reclaim 17 mgd of municipal waste water for industrial cooling purposes. Biological treatment methods are used to remove BOD; excess lime softening is used to remove phosphates; and recarbonation is used to lower hardness. Experiences with the reuse of waste water for irrigation are described. Reuse and conservation of water used in the textile industry are suggested to lessen the drain on water resources of the surrounding areas. Microscreening to remove suspended solids from combined sewer overflows and the use of ozone to remove color, taste, odor, and microorganisms from storm water are described. In a pilot plant, coarse screens were used to remove large particles from waste water before microscreening. Screened effluent is then fed at a controlled rate to a continuous co-current contact chamber for ozonation. Analyses of treated effluent indicated that ozonation resulted in reductions in all of the contaminants except total phosphorus. The use of treated combined sewer overflows is suggested for irrigation, artificial recreational lakes, and other industrial purposes.

A009

STORM OVERFLOW DESIGNERS NEED GREATER FEEDBACK,

Surveyor, Vol. 150, No. 4448, p 22, September, 1977.

A recent report of the Working Party on Storm Sewage (Scotland), published by the Scottish Development Department, has suggested that although information is sketchy, storm overflow does not appear to be a serious problem in Scotland. The survey by the Working Party indicated that of the 2000 storm overflows observed in Scotland, approximately 20% could be considered hazardous by local authorities. The report suggested that Scottish rivers were probably able to assimilate the storm water without adverse effects and that elimination of all storm overflows was probably not economically feasible. A series of 10 recommendations were presented: direction of storm water to sanitary sewers in industrial areas served by separate systems, elimination of dual manholes, identification of existing storm and sanitary sewers, inspections and supervision of overflows and connections to sanitary sewers, designing of sewers and manholes to minimize blockage, and use of storage or settling basins where feasible.

A010

DESIGNING RETENTION BASINS FOR SMALL LAND DEVELOPMENTS,

Kelly, H. G.

McElhanney Surveying and Engineering Limited,
Surrey, British Columbia, Canada.

Water and Sewage Works, Vol. 124, No. 10, p 78-80, October, 1977. 3 fig, 1 tab.

An expanded model to provide design criteria for estimation of retention basin volumes for small land development projects has been reviewed. The time of concentration in the developed catchment basin and the attenuation of runoff intensity with time following the instantaneous peak rate of catchment basin discharge are incorporated. The model is recommended for use where analysis with synthetic hydrographs is not practical and where controlled rates of discharge are required. Intensity, duration, and frequency rainfall curves may be linearized in natural or logarithmic form. An equation for the outflow volume to the condition of peak storage in the retention basin is derived. Equations for the volume of inflow during the period of increasing storage and for the volume of storage are presented. The model is used in the calculation of a design for a cul-de-sac in a 7.7-acre development intended for single family occupancy.

A011
PLANNING FOR URBAN STORMWATER CONTROL,

Fell, W. J.

Fell Brusso Bruton and Knowles, Incorporated,
Tulsa, Oklahoma.

Public Works, Vol. 108, No. 10, p 90-93, October, 1977.

A method for deriving the time of concentration or the time required for water to travel from the farthest part of a watershed to its drainage is presented for use in calculating the shape of a storm water hydrograph. A series of equations for expressing peak flood flows as functions of the area of the given watershed, the slope, and the average annual precipitation is given. An equation for the volume of flow or the area under the hydrograph is used to derive the runoff per sq mi and the time to peak. Inches of runoff are computed for recurrence intervals of 10, 25, 50, and 100 years and losses are subtracted for depression storage, infiltration, interception, and evapotranspiration. The Tulsa area in Oklahoma is used to illustrate computation of time of concentration with allowances for channel slope and length. The relationship between time of concentration, channel length, and slope is presented graphically for 10- and 25-year storms.

A012
URBAN STORM RUNOFF MODEL,

Rovey, E. W., and Woolhiser, D. A.

CH2M Hill,
Saint Louis, Missouri.

Journal of the Hydraulics Division-ASCE, Vol. 103, No. HY11, p 1339-1351, November, 1977. 8 fig, 3 tab, 12 ref.

Kinematic equations for overland flow and flow in an open channel, as well as the derivation of an infiltration curve as a function of time from ponding and infiltration rate, are presented. A computer model has been developed to approximate the response of a watershed to a specified rainfall event with respect to overland flow on a rectangular surface, open channel flow in a trapezoidal channel, free surface flow in a circular conduit, and general watershed geometry. Input required for the model includes geometric parameters estimated from a topographic map of the watershed, parameters for surface resistance to flow, and infiltration parameters for pervious surfaces. Overland flow resistance coefficients are listed for various surface types. The 165-acre Hillcrest Drain watershed in Northglenn, a suburb of Denver, Colorado, is cited as an example of the use of the model to simulate runoff hydrographs with input of several observed rainfall hyetographs. Simulations of three observed storms were marked by underestimation of the initial peak of discharge and overestimation of the peak rate and volume, although peaking timing prediction was good. For a storm which consisted of two definite pulses of rainfall, the first peak was underestimated while the second peak was overestimated. The inability to predict the difference between actual rainfall and all losses is suggested as contributing to the differences between actual and computed results. Problems associated with estimation of the antecedent moisture condition of the soil and with the spatial distribution of gauging stations within the watershed are discussed.

A013

EFFECTS OF STORM FREQUENCY ON POLLUTION FROM URBAN RUNOFF,

Whipple, W., Jr., Hunter, J. V., and Yu, S. L.

Water Resources Research Institute at Rutgers University,
Cook College Campus,
New Brunswick, New Jersey.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2243-2248, November, 1977. 8 fig, 5 ref.

Since one of the basic assumptions of SWMM, the EPA's storm water management model, is that the pollution loading from urban runoff in a given storm varies with the length of time elapsed since the preceding rainfall, studies were conducted to test the assumption. A highly urbanized part of the Saddle River watershed in New Jersey was chosen as a test area for various methodologies to evaluate pollution from urban runoff. Heavy metal concentrations were measured in samples taken at 5-minute intervals throughout storm hydrographs of a number of events. Samples collected along three tributaries of the Saddle River were also analyzed for BOD, total phosphates, and suspended solids. The data suggested that there is a tendency for storm loadings of heavy metals to increase with total runoff during the storm, although no variation was observed with respect to the number of days since the preceding rainfall. The variation in phosphates with respect to the number of days elapsed since the last storm event was significantly different for each of the tributaries, ranging from a slightly positive correlation to a negative one. Suspended solids concentrations tended to decrease with the time elapsed since the last rainfall, but BOD concentrations did not exhibit comparable trends. Although the data reported were not sufficiently exhaustive to negate SWMM's basic assumption, serious doubt in the model's validity is expressed.

A014
STORM SEWAGE OVERFLOWS,

Tottill, P. R.

Department of the City Engineer,
Liverpool City Council,
Liverpool, England.

Chartered Municipal Engineer, Vol. 104, No. 10, p 181-186, October, 1977. 6 fig, 18 ref.

Because flow in combined sewers can increase by 50 times during wet weather, it is frequently necessary to use a storm overflow chamber to decrease the load on sewers further downstream. Available storm overflow chambers include the high side weir, the stilling pond, and vortex overflows. Most research and development has been concentrated on improving conventional types of overflow treatment equipment. Some more recent developments show promise, but are relatively untried. The normal choice will be either a stilling pond or a high side weir with provisions for storage. Further research on the vortex overflow could produce an improved, more compact overflow chamber. Because small changes in an overflow chamber can affect performance considerably, model tests are important in designing an overflow chamber. The re-establishment of a technical committee to review research conducted since 1971 is recommended.

A015
WORKING PARTY ON THE HYDRAULIC DESIGN OF STORM SEWERS,

Chartered Municipal Engineer, Vol. 104, No. 10, p 189-190, October, 1977.

New procedures for designing storm sewers and a design practice manual are being developed. The Working Party on the Hydraulic Design of Storm Sewers in England came into existence in March 1974. A pilot study found no systematic relationship between movement of intense rainfall and winds. Computer programs are being developed to simulate the hydraulic behavior of storm sewer systems. The improved design methods will probably include means of choosing appropriate values for rainfall data for calculation of the peak discharge for a required return period. More realistic modelling of above-ground hydrology and storm water flow in the sewer system is being developed. The design practice manual is expected to be available in 1979. The working party maintains communication with other organizations involved in setting standards for sewer design.

A016

BEST MANAGEMENT PRACTICE FOR URBAN STORM AND COMBINED SEWER POLLUTION CONTROL,

Murphy, C. B., Jr., Drehwing, F. J., Jordan, T. A., and Carleo, D. J.

Water and Sewage Works, Vol. 124, No. 11, p 81, November, 1977.

Since non-point sources are major contributors of urban water pollution, interest has been directed toward the control of storm water and combined sewer overflow discharges. The application of Best Management Practices (BMP) has been suggested as a rational and cost-effective solution to the abatement of both storm water and combined sewer overflow. Surface flow attenuation, porous pavement, erosion control, restrictions on chemical usage, land-use planning, and improved sanitation practices are suggested as abatement measures in source management. Collection system management alternatives include: inflow/infiltration control, improved system regulation and control, polymer addition for friction reduction, and collection system maintenance programs. Conventional vacuum sweepers have been recommended for removing the light fraction of total suspended solids from storm water. Hydraulic analyses of the collection system are recommended for a program of collection system management.

A017

AUTOMATIC CONTROL STRATEGIES FOR URBAN STORMWATER,

Trotta, P. D., Labadie, J. W., and Grigg, N. S.

Northern Arizona University,
Flagstaff,
Department of Civil Engineering.

Journal of the Hydraulics Division-ASCE, Vol. 103, No. HY12, p 1442-1459, December, 1977. 5 fig, 4 tab, 22 ref.

The efficiencies of automatic control strategies for sewage treatment plants were compared under simulated storm conditions. The control methods were analyzed using the San Francisco Master Plan as the treatment plant case study. Reactive control, adaptive control with limited forecast or with quadratic objective, and stochastic adaptive control with quadratic objective or with linear objective were compared according to their ability to predict storm water quantity and quality and to control overflow. Storm water inflows to subbasins, calculated over 20-min intervals for 3-1/3 hrs of the simulated storms' duration, ranged 1-1,500 cu ft/sec. The results of the simulation showed that a certain degree of storm prediction by control strategies was necessary for overflow control. Reactive control was the least effective system for the prevention of overflow tested, while adaptive control with limited forecast proved to be the safest. When the risk of forecast errors in the other three control strategies was taken into consideration, limited forecast provided better results because of the high degree of forecast error associated with stochastic adaptive control with linear objective. Stochastic adaptive control with quadratic objective proved effective even with a high degree of error in prediction. A hierarchical algorithm was designed for an automatic control system.

A018
HIGH WATER DISCHARGING OR RAIN BASINS? (Hochwasserentlastungen odor Regenbecken?),

Munz, W.

EAWAG,
Duebendorf, West Germany.

Gas-Wasser-Abwasser, Vol. 57, No. 12, p 861-868, 1977. 5 fig, 2 tab, 8 ref.

Criteria used in Switzerland for the selection of storm water storage tanks and combined sewer overflow facilities are discussed. Although the installation of stand-by storage tanks is not required for facilities whose capacities are only exceeded during intense storms, stand-by storage facilities are recommended for reducing the load on the treatment plant during wet weather. The effects of the volume of storm water storage tanks and the maximum flow rate towards the treatment plant are evaluated with respect to the magnitude of the combined sewer overflow. Several storm water and treatment configurations currently in use in Switzerland are reviewed. A formula which considers the degree of protection required for receiving waters is presented for the selection of design capacities and storage volumes for storm water treatment facilities.

A019
EVALUATION OF STORM WATER ROUTEING MODELS,

Zaghoul, N. A.

Proceedings of the Institute of Civil Engineers (London), Vol. 63, Part 2, p 925-933, December, 1977. 6 fig, 9 ref.

Three storm water transport routing systems were compared. The Dorsch hydrograph volume method (HVM), the Water Resources Engineers' model (WRE), and the storm water management model (SWMM) were evaluated using the same runoff inlet hydrographs. The three models were tested in simulation studies with the Bannatyne combined sewer watershed in Winnipeg, Ontario, Canada. The 542-acre Bannatyne watershed was divided into 41 subcatchments, ranging in size from 5 to 23 acres and in imperviousness from 23 to 75%. Transport routes were compared under normal flow conditions. Outflow hydrographs predicted by the models were compared to the outflow hydrographs recorded during a storm of low intensity and long duration and during a storm of medium intensity and short duration. The evaluation indicated that the SWMM model was not as accurate under surcharge conditions and should be used primarily in studies of storm water management and planning. The Dorsch HVM and WRE models provided more realistic storm sewer network designs.

A020

INFILTRATION FORMULA BASED ON SCS CURVE NUMBER,

Aron, G., Miller, A. C., Jr., and Lakatos, D. F.

Pennsylvania State University,
University Park,
Department of Civil Engineering.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 103, No. IR4, p 419-427, December, 1977. 3 fig, 4 tab, 9 ref, 1 append.

An equation for determining infiltration based on rainfall, runoff, and soil water storage capacity is presented as an alternative to Hortons Law. The infiltration equation utilizes United States Soil Conservation Service (SCS) runoff equations and soil curve numbers. The SCS formula for cumulative infiltration is dependent upon hydrologic soil complex curve numbers, which are based on soil permeability and land use, and soil water storage capacity. The infiltration equation based on the SCS formula is used to determine the cumulative infiltration as a function of soil characteristics and antecedent infiltration. The equation is reported to be adaptable to computer models and to eliminate the need for extensive on-site field tests because of the SCS soil properties and curve numbers used.

A021

CHARACTERIZATION AND IMPACT OF STORMWATER RUNOFF FROM VARIOUS LAND COVER TYPES,

Rimer, A. E., Nissen, J. A., and Reynolds, D. E.

Wiggins-Rimer and Associates,
Durham, North Carolina.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 252-264, February, 1978. 7 fig, 7 tab.

On-site investigations of the effects of regional land use on storm water runoff and surface water quality were conducted by the Triangle J Council of Governments of the Piedmont region of North Carolina under a grant authorized by Section 208 of the Federal Water Pollution Control Act. Sampling stations were erected in streams draining representative land use types, including: low activity rural, high activity rural, low activity residential, high activity residential, low activity commercial, high activity commercial and urban. In addition, four total load sampling stations and 11 rainfall gauges were established in the region. Non-point sources of storm water runoff were delineated by analyses of suspended solids, phosphorus, COD, lead, and dissolved oxygen concentrations in the water samples. A comparison of average peak concentrations of the contaminants with the type of land use indicated that pollution by non-point sources increased proportionally with respect to the amount of impervious land. Sampling stations in the streams were used to monitor temperature, dissolved oxygen, specific conductivity, and pH. A significant decrease in dissolved oxygen levels in the streams was observed after storm events. Point sources were found to have a greater impact on dissolved oxygen levels than non-point sources. The concentrations of suspended solids, total phosphorus, and lead in streams after a storm event were frequently in excess of 1983 water quality standards for the Triangle J 208 region.

A022
URBAN STORM WATER MANAGEMENT,

Moore, K. W.

Water Pollution Control, Vol. 116, No. 2, p 18, 20, February, 1978. 1 fig.

The integration of storm water management into land use and urban sewerage planning is discussed. A study of a large drainage area indicated the need for more grassland and a storm water reservoir to bring about a 50% reduction in the quantity of runoff and a significant decrease in BOD and suspended solids. Assessment of drainage areas can result in a reduction of peak discharge and pollutant loading of receiving waters. Storm water management requires the identification of problems, a review of the existing system, and evaluation of the effects of storm drainage and runoff which might influence the development of rural property. The control of pollution sources, erosion, and flooding, and storm water treatment should be implemented. Data on storm water control and economic alternatives should be collected. Storm water treatment and flow control can be achieved by the use of ponds, settling and storage tanks, sewer inlet controls, gate and weir controls, and swirl concentrators. Computer programs are also available for the prediction of storm water levels.

A023
EFFECTS OF UNRECORDED POLLUTION FROM URBAN STORMWATER RUNOFF ON BENTHIC MACROINVERTEBRATES OF THE GREEN RIVER, MASSACHUSETTS,

Pratt, J. M.

Dissertation Abstracts International B, Vol. 38, No. 8, p 3614, 1978.

The impact of pollutant-bearing runoff on benthic microinvertebrates was evaluated in a year-long investigation of the urban and non-urban areas of the Green River in Massachusetts. General water sample analyses showed that wet weather runoff levels were not usually biologically limiting. One sampling station was located above the primary urban area and five stations were established downstream from it. Using the Brillouin species diversity index, the urban mean diversity of collections declined from 4.4 to 3.0 in a downstream direction, while the upstream collection averaged 4.7. Collections in the spring were the most diverse. Diptera, Ephemeroptera, and Trichoptera were the dominant species in the upstream samples. The downstream urban samples showed high diversities of Diptera, Oligochaeta, and Gastropoda, with lower densities of Ephemeroptera and Trichoptera. Pollution-sensitive taxa were replaced by forms more tolerant of urban runoff; species dissimilarity was observed in samples obtained farther downstream. Pollution-sensitive species indicated that urban runoff disrupted the biota, particularly during summer periods of low flow. Urban runoff disruption appeared to be localized in the riverbed.

A024

RAPID CITY COMBATS THE EFFECTS OF URBAN RUNOFF ON SURFACE WATER,

Water and Sewage Works, Vol. 125, No. 2, p 48-53, February, 1978. 11 fig, 2 tab, 15 ref.

Urban runoff from a 2.70-sq mi watershed in Rapid City, South Dakota, was examined with respect to the pollutant loading on surface waters. COD, total suspended solids, volatile suspended solids, total and soluble phosphorus, and specific conductance were measured in samples collected during 15 urban runoff events over a five-month period. The COD content of the samples averaged 230 mg/liter. Other mean parameter values included: 2,564 mg suspended solids/liter; 225 mg volatile suspended solids/liter; 0.23 mg total phosphorus/liter; 0.11 mg soluble phosphorus/liter; and 365 microohms/cm specific conductance. Maximum parameter concentrations were observed in samples collected at the beginning of urban runoff events; high concentrations were found in peak flow samples. Additional studies evaluated the pollutant loading of the test watershed by a secondary sewage treatment plant discharging 7.5 mgd into the groundwater. A second watershed in the Rapid City area was sampled for urban runoff and used as a comparison to the test site watershed.

A025

LONDON'S STORMWATER PROBLEM,

Horner, R. W., Wood, L. B., and Wroe, L. R.

Department of Public Health Engineering,
Greater London Council,
England.

Public Health Engineer, Vol. 5, No. 6, p 146-151, 1977. 2 fig, 3 tab, 3 ref.

Methods of controlling storm water runoff into the river system in London, England, are reviewed. The London area is divided into six river basin districts containing more than 200 storm outfalls. The average municipal sewage flows from the six districts range 22-339 mgd with standard storm water flows of 22-327 mgd transported to treatment centers. A maximum of 603 mgd of storm water runoff flows into the river system in the Central London district. Monitoring equipment has been installed in the six districts to measure the impact of yearly storm water flows and effective oxygen loads of storm effluent on the River Thames and its tributaries. Storm water discharges into the Thames can deplete the dissolved oxygen content of the river water, depending upon the volume, quality, and discharge point of the storm water and the oxygen content of the river at the time of the storm. The state of the tide is a factor relative to the direction and speed of the storm water. Effective oxygen loads of the districts' water systems, during a standard storm, range 23-294 tons. Rapid storm water removal and storm water storage for gradual discharge are suggested for controlling storm water runoff into the Thames. Short retention of storm overflow with sedimentation and aeration at a sewage treatment plant is also being considered.

A026

SIMPLE METHODS FOR RAINFALL-RUNOFF-PROCESS. RUNOFF HYDROGRAPH CURVES FOR RAIN AND MIXED WATER CANALS (Einfache Modelle fuer Niederschlag-Abfluss-Prozesse. Abflussganglinien fuer Regen und Mischwasserkanaele),

Schulz, H. W. P.

Wasser und Boden, Vol. 30, No. 1, p 2-5, 1978. 7 fig, 3 ref.

Runoff retention and runoff hydrograph curves were derived from rainfall curcurves on the basis of translation and retention of water as applied to sewer system design. The basic models, integrated by means of hyperbolic functions, are suitable for engineering calculations. They are also more flexible than the summation curve and time constant methods.

A027

CALCULATION OF FLOW RESTRICTION LENGTHS FOR RAIN OVERFLOW AND BASINS (Berechnung der Drosselstrecke von Regenueberlaeufen und Regenbecken),

Munz, W.

EAWAG,
Duebendorf, West Germany.

Gas-Wasser-Abwasser, Vol. 57, No. 12, p 869-875, 1977. 10 fig, 4 tab, 8 ref.

A hydraulic study of the flow of water through a pipe culvert toward a treatment plant is applied to the limitation of storm water overflow conditions in a rain basin. The relationship of the inlet level to the culvert is calculated according to the difference in water flow heights before and after the culvert inlet. Positioning of the weir is dependent upon the upstream flow velocity in the incoming sewer. The height should allow an incoming velocity high enough to prevent sedimentation in the pipe. By simulating these flow conditions, unfavorable oscillations in the pipe can be avoided and proper flow established. By restricting these flow conditions in the culvert, self-priming action in the culvert may be controlled.

A028
CITY STORM SEWERS DUG IN CLOSE QUARTERS,

Highway and Heavy Construction, Vol. 121, No. 2, p 87, February, 1978.

A hydraulic backhoe was utilized in a storm sewer construction project which required excavation in the proximity of buildings, trees and other objects. The RH 12 backhoe, equipped with a 48-inch bucket, was employed to excavate 4-5 ft wide trenches at depths ranging 3-16 ft for the installation of storm sewers and underdrains in Nanticoke, Pennsylvania. The hydraulic backhoe was required to dig through alluvial deposits, hard rock, pavement, concrete, and asphalt for the laying of 12-36 inch reinforced concrete storm conduits. Blasting of hard rock was occasionally necessary before excavation by the RH 12 hydraulic backhoe. The excavation time logged by the backhoe for several thousand feet of storm drain installation amounted to 450 hrs. The project also included the construction of sidewalks, driveway aprons, concrete curbs and gutters, asphalt paving, and landscaping.

A029
STORM WATER MANAGEMENT MODEL DEVELOPED BY CIVIL ENGINEERS,

Water and Pollution Control, Vol. 116, No. 1, p 20, January, 1978.

University of Toronto's Department of Civil Engineering has developed a computer program to analyze storm water overflow characteristics under multi-storm conditions. The program model, called RAFFI, simulates the conditions of storm water runoff in a sewer system in one or more watershed areas during one or more storms. The computer model simplifies storm runoff measurement and also expands the capabilities of other programs. The computer analysis has been reduced from the conventional $300-400 for a six hour event to $15-20/computer run for a 6-month record. RAFFI monitors frequency, duration, volume, and pollution parameters of the overflows, including those which reach water bodies during storm runoff. Because the program's model simulates the overall performance of a sewer system during storm conditions, potential solutions to overflow problems are more readily available. The program model can be used in conjunction with more detailed models such as the Water Resources Engineers Model or the Hydrograph Volume Model.

A030

NEW FACILITY HELPS CLEAN UP BOSTON HARBOR,

Water and Sewage Works, Vol. 125, No. 4, p 62-63. April, 1978. 1 fig.

The $6.7 million Pollution Abatement and Flood Control Facility, constructed by the Boston, Massachusetts, Redevelopment Authority, provides screening and disinfection of storm runoff and combined waste water before discharge into Boston Harbor. The facility contains three, 48-inch, variable speed turbine pumps that are pneumatically controlled and rated at 65,000 gpm each. A 30-inch, electric motor-driven pump and the turbine pumps consist of vertical centrifuge, mixed flow, single-stage, and suction, dry pit-type units. The 1200 hp rated turbines, operated at 600 hp by Saturn turbine units, can accommodate solids up to 7 inches in diameter; the motor-driven pump can accommodate diameters up to 5 inches. The 32-ft vertical shaft speeds of the turbines are reduced to 1,000 rpm followed by a reduction to 395 rpm by Solar and Philadelphia gearboxes. During storm conditions, the electric motor-driven pump is activated when the level in the wet well increases to a specified height, followed by the turbines in sequential order. The pumps are equipped with manual override; the fuel oil-powered turbines are still operable in the event of a power failure. Future additions planned for the pumping plant include six detention tanks for solids settling and removal; the water is discharged through the Fort Point Channel to Boston Harbor.

A031

FLOCCULATION-FLOTATION AIDS FOR TREATMENT OF COMBINED SEWER OVERFLOWS,

Stanley, N. F., and Evans, P. R.

Hercules Incorporated,
Allegany Ballistics Laboratory,
Cumberland, Maryland.

1977. 92 p, 17 fig, 29 tab, 7 ref. Technical Report EPA-600/2-77-140.

Chemical flocculants and buoyant flotation aids were investigated for removing suspended solids from combined sewer overflows. Laboratory batch tests achieved a 70-100% suspended solids removal when 100 mg/liter of the polystyrene flotation aid Dylex KCD-340, 100 mg/liter of FeC13 as a coagulant, and 1 mg/liter of Hercofloc 810 as a flocculant were added. In pilot plant tests, the flocculants and buoyancy aids lost their effectiveness when stored for long periods of times. Suspended solids were reduced by 67-87% when problems with the chemicals and buoyancy aids were corrected; suspended solids were reduced by 50-77% with air flotation in the same pilot plant. The success of the process was considered economically dependent upon recovery and reuse of the flotation aids. Cleaning the flotation aid surface of adhering solids for reuse in the flocculation-flotation process was unsuccessful. Further investigations of the process were rejected in favor of air flotation treatment of combined storm overflows.

A032

OXON SYSTEM USES IN AND OUT PUMPS,

Surveyor, Vol. 151, No. 4479, p 22, April, 1978.

Four electrically-powered pumps are activated automatically when combined sewer overflow conditions occur in Carterton, Oxfordshire, England's storm drainage system. The storm drainage system consists of 2.5 miles of sewers servicing a town with a population of 10,000. The storm water flows to a pumping station which transports the waste water to a balancing pond for controlled discharge to a stream. Main pipes with diameters of 1.2 m drain into a 47,000 gal sump located at the pumping station. Three of the four 9,000 gpm pumps rechannel storm water overflows when the water level in the sump reaches a predetermined level. The fourth reserve pump is activated automatically in an emergency situation. The 950,000 pounds sterling storm water drainage project includes a generator to power the pumps in the event of power failure.

A033

STORM SEWAGE: SEPARATION AND DISPOSAL,

McGillivray, R.

Public Health Engineer. Vol. 6, No. 2, p 90-93, 1978.

Considerations in designing storm water disposal sewers were discussed in a symposium sponsored by the Scottish District Center and attended by the Scottish Working Party on Storm Sewage in Glasgow, Scotland, on December 14, 1977. Increases in dry weather sewage flows, industrial discharges to municipal sewers, water removal from rivers, paved areas, and changes in the properties of surface runoff have mandated the investigation of pollutants in surface runoff and separated or combined storm sewer designs. About 20% of the storm water overflows reported by districts in Scotland were termed unsatisfactory; the overflows had BOD concentrations in the range of 25-50% of those found in dry weather sewage flows. River purification boards in Scotland have adopted regulations allowing parts of industrial complexes to be connected to sanitary sewers, eliminating dual manholes functioning for separated sanitary and storm sewer systems, and encouraging the use of different pipe materials, such as fireclay and concrete, for sanitary sewers and for storm sewers to assist in identification. Stilling ponds were recommended for overflow systems to reduce flow velocities, reduce turbulence, and promote settling. High side-weirs were considered the most efficient means of overflow control. Storm sewer installations in several Scottish municipalities, pilot plant studies of storm water tanks, and combined sewer investigations were reviewed.

A034
BENEVAL: HOW TO GET MORE FROM YOUR STORM DRAIN DOLLAR,

Tettemer, J. M., and Vance, H. A.

Project Planning Division,
Los Angeles County Flood Control District,
California.

Public Works, Vol. 109, No. 1, p 43-44, January, 1978.

The Benefit Evaluation of Urban Storm Drains (BENEVAL) process, developed by the Los Angeles County, California, Flood Control District, utilizes a regression analysis equation for establishing priorities in voter-approved storm water drain projects. The BENEVAL equation incorporates the impacts of storm damage, traffic improvements, and pedestrian convenience in terms of public opinion and values. Initially, data is collected on approved storm drain projects; drainage impact parameters are defined; and the effect of each parameter on storm drain values is calculated. The final project value in dollars is then computed as a function of the flooding potential alleviated by the drain, the slope of the flood area, the length of the flow path, the flood plain population, the average daily traffic, and the assessed valuation along the flow path. The analytical technique is considered superior to straight cost-benefit and point system analyses.

A035
ESTIMATION OF DIRECT RUNOFF FROM URBAN WATERSHEDS,

Hossain, A., Ramachandra, A., and Delleur, J. W.

Indiana State Board of Health,
Indianapolis.

Journal of the Hydraulics Division-ASCE, Vol. 104, No. HY2, p 169-188, February, 1978. 16 fig, 3 tab, 17 ref.

Linear and nonlinear direct runoff systems models were applied to 11 watersheds in different stages of urbanization to determine watershed response, to develop a regional model describing the relationship between excess rainfall and direct runoff, and to calculate the response of urbanized watersheds to a short series of storms. A convolution integral described the linear relationship between rainfall excess and direct runoff; the Fourier transform method was utilized to calculate the instantaneous unit hydrograph (IUH) or the kernel function. A regional dimensionless IUH was formulated into a smooth curve by combining the dimensionless unit hydrographs from 10 of the watersheds. The regional dimensionless linear IUH evaluated a quasi-linear model that was developed to relate the rainfall excess with the direct runoff. Direct runoff in watersheds with varying degrees of urbanization was predicted by the IUH, when the estimated rainfall excess was incorporated, and also by the quasi-linear model. The nonlinear system model, which considered the rainfall excess as a series of impulses, was not as accurate as the quasi-linear model for predicting direct runoff. First and second order kernels, planar functions of the direct runoff output, were more regenerable for two storms than for six; the regeneration performance of the quasi-linear model was better than that of the nonlinear model.

A036

NATIONWIDE EVALUATION OF COMBINED SEWER OVERFLOWS & URBAN STORMWATER DISCHARGES. VOL. III: CHARACTERIZATION OF DISCHARGE,

Manning, M. J., Sullivan, R. H., and Kipp, T. M.

American Public Works Association,
Research Foundation,
Chicago, Illinois.

1977. 289 p, 77 fig, 132 tab, 111 ref, 2 append. Technical Report EPA-600/2-77-064c.

The characteristics of pollution originating in urban stormwater runoff and combined sewer overflows and the impact on receiving waters were studied by analyzing published and unpublished data. Available data was often derived from reports which did not focus directly on urban runoff but provided pollutant characteristics for other purposes; comprehensive studies of urban runoff pollution characteristics were recommended. Other recommendations included uniform and consistent sampling techniques and closer monitoring of flow quantity during flow quality measurement. Urban storm water discharge models were developed for utilizing census data to evaluate land use and population densities. Pollutants contributed by treated municipal sewage flows during storm conditions were identified as less extensive than pollution loads associated with urban runoff. Receiving water quality was affected by shock loads and solids accumulations associated with urban runoff during storm periods. Methods were developed for redesigning sources of urban runoff pollution such as vacant lot erosion, street surface runoff pollution, and roof leader drainage.

A037

ASSESSMENT OF MODELS FOR STORM AND COMBINED SEWER MANAGEMENT,

Wada, Y.

Technology Reports of the Kansai University, No. 19, p 109-114, March, 1978. 2 fig, 3 tab, 6 ref.

Five mathematical models were evaluated for accuracy in predicting storm and combined sewer runoff and pollutant deposition in storm and combined sewer systems. The Complete Mixing model and the Inaba model offered combined calculations of surface and pipe-deposit runoff. The Energy Operation model was a runoff model for pipe deposited systems. Combined runoff models incorporating the conservative momentum equation for water quality and quantity included the Deposited Pollution Load model and the Scored Pollution Load model. While all the models were considered easy to use, the Energy Equation model and the Deposited Pollution Load model were found to be more accurate in simulating runoff pollutant load on application to the Osaka, Japan, drainage system. The Energy Equation model calculated the runoff pollutant load as a function of critical scored flow, runoff rate, and residual load. A high degree of correlation was apparent between the observed and simulated BOD, ammonia-nitrogen, and phosphate loads in the runoff. The Deposited Pollution Load model calculated the surface runoff pollutant load, the flow rate, and the quantity of deposited pollutants as functions of water depth, rainfall intensity, catchment area, residual load, and travel time.

SEWER SYSTEMS

B001
NEED TO CONTROL DISCHARGES FROM SEWERS CARRYING BOTH SEWAGE AND STORM RUNOFF (RPT. TO THE CONGRESS),

1973. 54 p, 11 append. NTIS Technical Report B-166506.

A Congressional report by the Comptroller General of the United States is presented. Federal, state, and local efforts to abate and control discharges from combined sewers are examined. Possible adverse effects of combined sewer discharges are illustrated with five case histories. In general, federal and state efforts were considered inadequate in controlling pollution related to combined sewers. Legislative changes relating to combined sewers are presented. Federal construction programs and benefits available from phased construction of projects to control combined sewer discharges are described. Recommendations to the Environmental Protection Agency and comments by federal, state, and local governments are presented.

B002
METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, DES PLAINES, O'HARE CONVEYANCE SYSTEM,

1975. 218 p, 19 fig, 5 tab, 17 ref, 7 append. NTIS Technical Report PB-259-498.

An environmental impact statement is presented for a proposed project to construct a system of conveyance tunnels or interceptor sewers and drop shafts to transport waste water from a 65.2-sq mi area in the Metropolitan Sanitary District of Greater Chicago to the O'Hare Water Reclamation Plant. The report includes detailed descriptions of the present environment, covering such topics as climate, topography, geology, soils, hydrology, biology, air quality, land use, sensitive areas, population projections and economic forecasts, and other programs in the area. Project objectives, constraints, chronology of plans and studies, and alternatives to the proposed project are discussed. Aspects of the proposed project which are described include the main tunnel, branch tunnels, sequencing of tunnel construction, main shaft, drop shafts, and access manholes. The environmental effects of the proposed project are described. Federal/state agency comments and public participation are discussed.

B003
METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, DES PLAINES, O'HARE WATER RECLAMATION PLANT AND SOLIDS PIPELINE, VOLUME II. APPENDICES,

1975. 339 p, 22 append. NTIS Technical Report PB-259-497.

Appendices to the final environmental impact statement for the O'Hare Water Reclamation Plant and a solids pipeline in Chicago, Illinois, are presented. Topics discussed in the 22 appendices include: O'Hare area flood control activities, MSDGC TARP Program, O'Hare service area determination, health questionnaire and responses, geology, regional water resources, water conservation and reuse measures, justification of ultimate size, health aspects, odor control, process alternatives, solids handling alternatives, design criteria, HUD guidelines, flow projections, additional site information, a density graph and matrix for the city of Des Plaines, an aerosol literature survey, water quality data, 10 state standards, and EPA correspondence.

B004
SEAMLESS PIPE FOR SANITARY, STORM SEWERS,

Water and Pollution Control, Vol. 115, No. 8, p 23, August, 1977.

The Spiralene seamless pipe, available from UNX Ltd. of Orangeville, Ontario, can be used in gravity feed sanitary and storm sewer conduit systems. Spiralene pipe, which is produced from a high molecular weight polyethylene manufactured by Union Carbide Canada Ltd., is available in 20-ft lengths with inside diameters of up to 10 ft. Features of Spiralene pipe include a smooth inner surface, reinforced walls, and bell and spigot ends. Pipes can be joined by force fitting for storm sewers, fitted with a rubber ring gasket for sanitary sewers, or bead welded for use with corrosive liquids.

B005
DIGGING BEFORE PILE DRIVING SPEEDS HULL SEWER JOB,

Engineering and Contract Record, Vol. 90, No. 8, p 74, August, 1977.

Fedex and the Duquesne Piling Company are using partial pre-excavation before driving piles at the Hull area sewer project in Quebec, Canada. The sewage collection system will eventually traverse the 15 miles between Aylmer and a planned sewage treatment plant at Templeton. To eliminate the need for frames to line up piles before driving, the ditch is excavated to a depth of 19 ft below the surface and the first level of whales is emplaced. Vibratory driver/extractors are being used to drive all piles. After further excavation a second row of whales and struts is installed. The piles are being used to stabilize the 45-ft ditch in which the 8.5-ft diameter conduit is poured. The success of pre-excavation is dependent on soil type, working best in cohesive clayey soils.

B006
ECONOMY IN CONSTRUCTION OF SEWERAGE SYSTEM,

Banerjee, A. C.

Bokaro Steel Limited,
Bokaro, India.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 83-84, June, 1977. 3 fig, 1 tab.

Design modifications to reduce costs of manhole construction are described. The use of relief shelves is suggested as a means of eliminating the need for thicker walls in deep manholes. The shelves are used to reduce the magnitude of the active earth pressure thrust, the lever arm, and the moment about the base. An equation relating the degree of pressure reduction to the height of the wall and the depth of the relief shelf from ground level is presented. Construction of a relief shelf involves the emplacement of a bracket or foot step to hold a pre-cast slab or wooden plank. The use of relief shelves for a 1,500 mm x 1,500 mm manhole 4.05 m deep resulted in a 20% saving in construction costs. Total costs are compared for standard construction methods and construction with relief shelves.

B007
PIPEWORK IN RIVER OR SEA ENVIRONMENTS,

Surveyor, Vol. 150, No. 4445, p 13, August, 1977.

The Stanton and Stavely Group of British Steel Corporation's Tubes Division has begun producing a series of joints for ductile iron pipeline systems. A self-anchoring joint, the Tyton Anchor, is a modified version of the Tyton gasket in which a series of stainless steel locking teeth have been molded. The Tyton Anchor utilizes standard pipes and fittings with diameters of 80-300 mm and can be self-anchored at working pressures up to 10 bars. The joint is suggested for use in water and sewage pipelines for river crossings, or in ground with poor bearing strength. Stanton and Stavely also produce a Tie-bar joint for use with larger diameters of 350-1200 mm. The Tie-bar joint is also self-anchoring and is a harness version of the standard push-in Tyton or Stantyte joint. Suitable for long sea outfalls and river crossings, the joint consists of a welded flange near the spigot which is connected to a loose flange by means of tie bolts.

B008
BLUE-CODED PIPING SOLVES WATER SERVICE PROBLEMS IN CALIF.,

Water and Wastes Engineering, Vol. 14, No. 9, p 69, September, 1977.

The Alameda County Water District in California has begun using corrosion-resistant polybutylene piping because of extremely corrosive soil conditions in the area. The piping is color-coded, enabling easier tracing and separation of the water lines from other underground utilities. Alameda uses polybutylene tubing for 1, 1.5, and 2 inch water service connections in all single and multiple dwellings, as well as commercial and industrial facilities, for the installation of new systems and the replacement of older, corroded metal lines. Polybutylene's design stress (1000 psi at 73 F) enables the tubing to deliver 30% more volume than other plastic piping of the same outside diameter, and the added strength also allows use of thinner pipe walls. Other advantages of polybutylene piping are the lower costs compared with conventional copper tubing and the speed of installation.

B009
CITY FIGHTS GREASE AND ODOR PROBLEMS IN SEWER SYSTEM,

Public Works, Vol. 108, No. 10, p 74-75, October, 1977.

Heavy loadings of grease and oil into the 88 miles of sewage collection lines in Burlingame, California, created a need to evaluate alternative means of cleaning lines and lift stations of grease accumulations. Grease-dissolving agents tested included solvents, detergents, enzymes, and other chemical products. The studies indicated that special bacteria cultures from Bower Industries, Inc., (sold under the name DBC Plus Dried Bacteria Cultures) offered the most effective solution to the problem. A pilot study was initiated at two selected pumping stations with average daily flows of 23,000 and 90,000 gal. Of the several bacteria formulas offered by Bower Industries, the type A culture designed for use with domestic sewage was chosen for use. Seven days of heavy application of the culture were required in the initial treatment phase, followed by maintenance doses of 1 lb of culture every three days for the 23,000-gpd station and 3 lbs of culture every three days for the 90,000-gpd station. The cultures, formulated for use with animal and vegetable oils and petroleum derivatives, were added to the pumping stations as a slurry with a water:dry culture ratio of 2:1. A 1-2 hr presoak period is required to fully activate the lyophilized and air-dried cultures. Ammonium phosphate was added to the slurry to insure adequate supplies of nitrogen and phosphorus for the bacteria during the initial heavy cleanup stage. Additional beneficial side effects of the grease removal program included easier servicing of submersible pumps and reduction of odors.

B010
FLOWMETER MOUNTINGS SOLVE PROBLEMS IN MUNICIPAL I & I STUDY,

Daniels, P.

Water and Sewage Works, Vol. 124, No. 9, p 94-95, September, 1977.

An inflow and infiltration study conducted in Philadelphia, Pennsylvania, by Southern Line Cleaning, Inc., may become the prototype for evaluations of other vintage municipal sewer systems. Flow is being measured at master control points, key manhole meter locations, and other selected sites to provide information on dry and wet weather high groundwater conditions, and on the effects of rainfall. For simplification, the Philadelphia system was divided into a series of subsystems and mini-systems with a broad range of age variance. The systems were presented on a series of 121 plats to aid in selecting the approximately 500 meter locations used in the monitoring program. Several types of flowmeters were tested for use in Philadelphia before the NB Instruments float meter was chosen, including ultrasonics systems and dipper meters. Offset of the manholes instead of direct positioning above the sewers caused problems in centerline mounting of the meters. A modified type of transducer arrangement in which a roof-mounted bracket was equipped with a float rod appropriate to the effective head depth was used. Waterproof materials were necessary since the meter element may be submerged in a combined system's mainstream under conditions of high inflow.

B011
LICKING OPERATIONAL PROBLEMS THE HARD WAY,

Nicolai, B.

Meriden Sewer Authority,
Meriden, Connecticut.

Water and Wastes Engineering, Vol. 14, No. 9, p 51-52, 54, September, 1977.

Operating problems at the Rasted Lane pumping station resulted in an inspection of several pumping stations in the Meriden, Connecticut, sewage system. Problems at the Rasted Lane station included an inoperative 50-hp 1500-gpm motor with bearing failure, a jammed gate valve, and failure of the remaining pump due to overloading of the combined thermal heater. A survey of other pumping stations revealed similar problems. Modifications were made to the system to allow simultaneous operation of the pumps and to provide a stand-by system in case of power failure. Goodkind and O'Dea, Inc., were retained as consultants to design additions to increase pumping capacities of four of the pumping stations. As part of the sewer renovation program, "package can" pumping systems are being phased out.

B012
SWAMPY SEWER JOB MOVES WITH BIG BACKHOES,

Highway and Heavy Construction, Vol. 120, No. 10, p 142, October, 1977.

Two large backhoes were used by Marvec-Allstate, Inc., of Verona, New Jersey, for the emplacement of 7 miles of large diameter interceptor sewers in Ocean County, New Jersey, as part of a $5.2 million project for the Ocean County Sewer Authority. The two Koehring 1266-D backhoes, equipped with 6-cu yd digging buckets, allowed emplacement of the sewers at a rate of 500 ft/day in spite of unfavorable hydrologic and soil conditions. In the western part of the project, 20,000 ft of 20- and 24-inch diameter prestressed concrete gravity flow pipe was installed in open-cut, sloped trenches equipped with steel trench boxes. The eastern half of the project required the installation of three side-by-side pipelines to transport raw sewage from the island communities and to carry treated effluent to an ocean outfall. A dewatering system was necessary because of the area's high water table and special precautions were necessary because of underground cables in the area.

B013
SLAG AND QUARRY WASTE AS PIPE BEDDING MATERIAL,

Banerjee, A. C.

Bokaro Steel Limited,
Bokaro, India.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 89-90, June, 1977. 4 fig, 2 tab.

External loading and internal stresses on a buried rigid sewer pipe can be influenced by a variety of factors, including the nature of the backfill, the unit weight of the filling material, the vertical load of the soil due to overburden, and the width of the trench. The type of bedding and the diameter of the pipe also place constraints on the depth of overburden which can safely be placed in the trench. The safe depth of the overburden for 600-mm diameter pipe would be 1.75 m for ordinary bedding and 3.25 m for first-class bedding. The use of slag and quarry wastes in a configuration with 15 mm crushed stone, 20 mm granulated blast furnace slag, and quarry dust increases the allowable overburden depth to 5 m. Use of the slag and quarry wastes instead of concrete cradle bedding results in a savings of 59 rupees/m of pipe.

B014
"PIGGY-BACK" SEWER SOLVES OVERLOAD PROBLEM,

Bieszczat, T. E.

Shafer, Kline, and Warren,
Civil Engineers,
Overland Park, Kansas.

Public Works, Vol. 108, No. 10, p 87-88, October, 1977. 1 fig.

Existing sewer mains were not considered adequate to handle wet weather flow and flow anticipated for the St. Joseph's Hospital complex in Kansas City, Missouri. Several options were considered to increase the sewage capacity without extensive reconstruction. Pressurizing the existing main with bolt-down manhole rings and covers on existing and proposed manholes was not considered feasible because of the age of the existing mains and the calculated peak flow of the hospital. The construction of a supplementary line was hindered by a solid limestone ledge through which any parallel sewer would have to be installed. Replacement of the existing line with a new one in the same trench would be costly and would require interim facilities to handle the flow during construction. The installation of a "piggy-back" supplementary line directly above the existing main was chosen and required a minimum of reconstruction. Use of the existing trench eliminated the need for rock removal and interruption of service. Armco Steel Corporation manufactured the 12 and 15 inch pipe used for connection of the hospital complex to the existing main. Slight modifications to the existing manholes were necessary. The application of the piggy-back solution to alleviate sewer maintenance problems in Leawood, Kansas, is described.

B015
SEWAGE COLLECTION SYSTEM RELIEVES THREAT TO FLORIDA
OYSTER INDUSTRY,

Water and Sewage Works, Vol. 124, No. 8, p 64-65, August, 1977.

An AIRVAC vacuum sewage collection system was installed at Eastpoint, Florida, to relieve pollution of Apalachicola Bay and eliminate environmental hazards to the area's oyster industry. Cost estimates for the vacuum system were $375,000 or 42% less than for an equivalent gravity line collection system because of the area's low topography and water table. Because Eastpoint is in a flood-prone area, valves will operate totally submerged with above-ground venting. Also, several pits were installed above grade to prevent valve flooding. Additional cost savings were realized by shallower trenching, the use of small-diameter PVC pipe instead of large-diameter clay pipe, and the omission of a series of expensive pumping stations. Three-inch PVC lines brought to grade and enclosed in water boxes have replaced standard sewer manholes. Field experience has indicated that valves should require minimal maintenance and should last for 50 yrs with little or no repair. Two collection stations, 15 miles of PVC vacuum lines, and 456 individual hookups comprise the system which will handle 165,000 gpd of municipal waste.

B016
SEA BED INSTALLATION FOR SEWAGE PIPELINE,

Dock and Harbour Authority, Vol. 58, No. 680, p 134, July, 1977.

An underwater sewage pipeline is being constructed by the Engineering Division of John Laing Construction at Sunderland, Tyne and Wear, England. Commissioned by the Northumbrian Water Authority, the contract includes the supply and fabrication of 300 m of 1.4-m diameter pipe for the outfall site and a marine survey of the sewage outfall area. The pipe will be fabricated, welded into 120-m lengths, and coated with concrete at Hudson Dock. Pipe trenches will be dug by a grab-equipped crane which is mounted on a pontoon. Sections of pipe will be towed to the outfall site by a tug and the trench will be backfilled. The pipeline will lead to a concrete-coated diffuser in the Wear River. Untreated sewage will be screened and sludge removed at the Hendon Treatment Plant before disposal into the sea through the pipeline and outfall system.

B017
SEWERAGE OUTFALL PROTECTED,

Corrosion Prevention and Control, Vol. 24, No. 4, p 30, August, 1977.

A sea outfall constructed in 1973 for the Southern Water Authority in England includes a diffuser system with 50 outlets at the sea floor and a terminal outlet. Winn and Coales (Denso) Ltd. supplied an anti-corrosion system to protect joints in the diffuser outlets, diffuser pipes, the main sluice valve, and bolted pipe couplings. A 42" diameter steel pipe 3,350 m long will lead from the Mewsbrook Treatment Works near Rustington to the diffuser system.

B018
CAN THIS SEWER PROJECT HAVE RECREATIONAL BENEFITS?,

Tracy, J., and Simmons, C.

Board of Water and Sewer Commission,
Northborough, Massachusetts.

Public Works, Vol. 108, No. 10, p 96-98, October, 1977.

A sewer construction project for 5 miles of interceptor sewers 15-30" in diameter was designed by Camp, Dresser and McKee, Inc., of Boston for the town of Northborough, Massachusetts. Preliminary studies were conducted to determine whether any recreational benefits could be derived from the project for the Assabet River through reclamation of disturbed lands. The study concluded that the installation of an interceptor system could be coordinated with the construction of a recreational trail system. Studies on the physical feasibility of such a system indicated that the pipeline could be located within the undeveloped river margins without incurring high land acquisition costs or displacing residents and businesses. Specific design recommendations for the proposed trail system included a 250-ft separation between the trail and any dwellings, continuation of the trail on sidewalks and streets in densely populated areas, a large number of trail access points, prohibition of recreational vehicles on the trail, and possible connection with the Wachusett aqueduct right-of-way.

B019
AN OLD BRICK SEWER FINDS A SILVER LINING,

West, R.

Surveyor, Vol. 150, No. 4448, p 8-10, September, 1977.

A television monitoring program of the sewer system in the town of Kidderminster in England revealed the deteriorated condition of a 900 x 675-mm brick combined sewer. Conventional sewer repair processes were hindered by the fact that 65% of the sewer ran underneath the area's carpet factories. Edmund Nuttall's Insituform technique in which a tube of terylene needle felt, covered with polyethylene and impregnated with polyester resin, is used to line an existing sewer was chosen. The 12-mm thick tube is transported to the site and emplaced while still in a liquid state so that irregularities in the sewer contour did not pose severe problems in the lining process. Cement grouting was forced under pressure through holes drilled in the cured lining to backfill any cavities. Two 200-mm and one 150-mm Univac pumps were used to eliminate any danger from storm water flow during the lining processes. A "flow-through" inflation bag was placed inside the lining tube to accomodate any surplus flow. The sewer was cleaned before emplacement of the lining and the lining material was transported to the site by refrigerated truck in 35-ft lengths. The lining is inflated with a low-pressure air blower and cured with a steam-air mixture at 70 C.

B020
DEVELOPMENT AND LAYING OF PIPES,

Water Services, Vol. 81, No. 978, p 473-474, August, 1977. 1 ref.

Various aspects of pipeline technology and pipeline design are discussed. Future developments in the use of flexible-type conduits are expected with increased interest in the use of glass fiber reinforced plastics, the use of pipe materials with thinner walls, and the use of larger-diameter bulk transmission mains. The use of a wide variety of pipe materials also requires the development of appropriate pipeline installation practices. Site evaluations are suggested to insure the most cost-effective method of installation. The development of equipment for backfilling and excavation and of other products such as self-anchoring joints is suggested to speed up installation and thereby significantly reduce total costs. Specialized construction materials or pipe linings to repair existing mains and to protect pipelines from corrosive soils, effluents, and soluble sulfates may reduce future maintenance and construction costs.

B021
SEWER REHABILITATION CUTS INFILTRATION,

Li, E. C. C.

Water and Sewage Works, Vol. 124, No. 11, p 86-87, November, 1977. 2 fig, 1 tab.

An infiltration/inflow study was conducted by East Texas Engineering and Construction Company for Rayburn Country, a development in East Texas with 21 subdivisions and 204,294 ft of sewer line. Exfiltration and smoke tests indicated that much of the infiltration/inflow came from 40,470 ft of sewer lines and 195 manholes in 5 of the 21 subdivisions. The system, constructed in 1966 of concrete pipe with rubber gaskets, was checked by a three-man testing crew and three workers with a backhoe loader tractor. An air-loc ball was used to plug a water-filled section of sewer and the amount of water loss over a given time was used as a measure of exfiltration rate. Smoke tests with a portable 1,500-cfm blower and smoke bombs were used where exfiltration testing was difficult. Causes of the 217 sources of extraneous flow found in the testing program included: leaks in precast concrete manholes; inflow through low or perforated manhole covers; leakage through cracked, offset or open joints; deterioration of the concrete encasements which connected cast iron and concrete pipes; root intrusion; faulty house laterals; and pipe breakage, joint offsets, and cracked bells caused by reverse grade and improper bedding and backfilling. Shear pipe breaks were more commonly observed than beam breaks and no longitudinal breaks were found. The rehabilitation project has repaired 126 line leaks and 91 manhole perforations so far, as well as replacing 1,204 ft of sewer line, to reduce infiltration by 60%.

B022
I/I STUDY TURNS TO T. V.,

Lamberton, R.

Larkin and Associates,
Kansas City, Missouri.

Water and Wastes Engineering, Vol. 14, No. 10, p 30-32, October, 1977.

A sewer infiltration/inflow study was conducted by Ace Pipe Cleaning, Inc., and Larkin and Associates of Kansas City, Missouri, for the city of Warrensburg at an estimated cost of $45,000. The study was required by the EPA and state agencies in Missouri as part of a proposed sewer system renovation project. A complete inventory and mapping of the sewer system was carried out to identify manholes subject to inflow because of top elevation, location, and condition. Smoke testing located point sources of direct entrance of storm water inflow and all sewer lines were cleaned and inspected by television. The program located 60 defective manholes and 160 inflow points which were designated for correction.

B023
BENEFITS FROM GROUTING AN ENTIRE SEWER SYSTEM,

Wass, V. C., and Bush, C. M.

Lower Allen Township Authority,
Camp Hill, Pennsylvania.

Public Works, Vol. 108, No. 11, p 55-57, November, 1977. 1 tab.

An extensive 2-year program for sewer renovation in Camp Hill, Pennsylvania, was conducted in response to waste water flow measurements which indicated that actual flow was 3.2-6.0 mgd when it should have been in the range 1.6-2.0 mgd based on the population size serviced by the sewer system. Video Pipe Grouting, Inc., was contracted by the Lower Allen Township Authority for the project, which included cleaning and chemical grouting with closed circuit television inspection of the area's 76 miles of sewer lines. An initial inspection by Video Pipe revealed roots from fast-growing pin oak, maple, and sycamore trees in the 20-year-old system and associated infiltration/ inflow. Rehabilitation of the system included removal of root growths, sealing of leaking joints with grout which contained a root inhibitor, cleaning of all lines, and cementing of manhole walls where infiltration was particularly heavy. Average flow was reduced by the rehabilitation program to 1.5 mgd, resulting in lower waste water treatment costs for chemicals, electrical power, general operating costs, and collection system repairs.

B024
BEAM BEHAVIOR OF BURIED RIGID PIPELINES,

Pearson, F. H.

California University,
Berkeley,
Sanitary Engineering Research Laboratory.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 767-783, October, 1977. 7 fig, 9 ref, 3 append.

Buried rigid pipelines or sewer lines can behave longitudinally as beams, developing shear forces and bending moments if subjected to nonuniformly distributed loads or reactions. Since current pipeline design criteria only consider minimum depth of cover and pipe length with respect to beam behavior, theories and applications of elastic beam behavior are discussed with respect to pipelines. Equations are presented defining the two categories of characteristic pipe length on which the elastic foundations of beam behavior are based. For short pipes the bedding reactions as well as the shear forces and bending moments induced in the pipe can be described by static analysis. For a longer pipe static analysis would, however, give higher than actual values for shear and moments due to a concentrated load. Bedding reactions and moments and shears in short pipes are discussed with respect to the effects of a concentrated surface load and of a nonuniformly distributed earth load. Dimensionless parameters of deflection, slope, moment, and shear are discussed for point loading and a concentrated surface load with respect to pipe of infinite length. Shears and moments are discussed with respect to medium-length pipes in which the maximum bending moment occurs at the point of application of the load. Practical applications are presented with equations to estimate the shear forces in spigot- and bell-jointed buried rigid pipelines and in O-ring jointed pipelines under anticipated normal conditions of construction and control; and to calculate the maximum bending moment in a buried pipe due to a surface load such as a truck wheel.

B025
BEACH, HIGHWAY AND SEWER PLAN ROLLED INTO ONE,

Engineering News-Record, Vol. 199, No. 14, p 44, October, 1977. 1 fig.

The $17-19.5 million Great Highway-Ocean Beach project was initiated as a multi-purpose project, since construction of a large consolidation sewer line was expected to remove or damage most of the existing upper Great Highway in San Francisco. The program included reconstruction and redesign of the highway for a distance of 3.6 miles, restoration of sand dunes, and creation of a linear park, along with construction of the sewer line. The plan was designed by Michael Painter and Associates of Sausalito, and Tudor Engineering Company and Chin and Hensolt of San Francisco, California. The plan recommended lowering the profile of both the highway and beach, extending the beach 200 ft west to add 48 acres of recreational area. The dunes would be revegetated and beach access would be improved. A curving four-lane highway with bicycle paths would replace the existing stretch of highway, which had been partially blocked by encroaching sand dunes.

B026
SEWERS VERSUS SEWERLESS METHODS--A REPORT BY A CONGRESSIONAL COMMITTEE,

Leich, H. H.

Compost Science, Vol. 18, No. 4, p 26, August, 1977.

The advantages and disadvantages of centralized waste water treatment and home disposal systems were evaluated in a congressional report by the Subcomittee on the Environment and the Atmosphere, a division of the House Committee on Science and Technology. Conservative attitudes in sanitary engineering are cited as a stumbling block in the use of innovative technology in municipal waste water treatment. The need for consideration and development of viable alternatives to costly sewage treatment facilities which require a great deal of land is discussed. Self-contained household waste water treatment and disposal systems have been suggested as reasonable alternatives to regional collection and treatment systems. Current trends, however, are against the continuing use of septic tanks and the acceptance of sewerless toilet systems. Studies which define current individual and small unit technology, as well as costs, are recommended.

B027
R7-M JOHANNESBURG SEWER TUNNEL,

The Civil Engineer in South Africa, Vol. 19, No. 7, p 163, July, 1977.

The 7-km long Bushkoppie outfall sewer is being built as part of a sewer construction program being conducted by the city of Johannesburg in South Africa. During the second phase of the program a second, 9-km long sewer tunnel will be constructed to join the Bushkoppie sewer at about 3.5 km from the proposed Bushkoppie sewage treatment plant slated for operation by 1981. The upstream portion of the tunnel will have a D-shaped cross-section and will be 2 x 2 m. The section below the confluences will be enlarged to a height of 2.5 m and a width of 2.75 m. The tunnel, which runs through residual lava of the Vertersdorp system with a depth below ground level of 5-60 m, will be lined with 300 m of dolomitic concrete. Steel arches at 1-m spacing with wire mesh and shotcrete are being used to reinforce the tunnel in unstable sections. The use of dolomitic aggregates and a 75-mm concrete cover are expected to alleviate the effects of corrosion in the tunnel, which will only have two vent shafts and a maximum slope of 1:1200. LTA Construction and Bomat Civil Engineering were contracted for construction and tunnelling in the 7 million rand project.

B028

A GUIDE TO SPECIFICATION OF GLASS LINED PIPE,

Williams, L. M.

Water and Sewage Works, Vol. 124, No. 10, p 76-77, October, 1977.

Since the use of glass-lined pipe in sewage treatment plants has been increasing, a series of guidelines or specifications for glass linings is presented to aid the potential user in selecting a product which will provide years of service and trouble-free installation. Although there are no measurement references for lubricity or resistance to friction, the lining should have a vitreous appearance equivalent to that of opaque window glass. A hardness of 5.5 or higher on the MOHS hardness scale is required. In addition, the glass lining-to-metal bond should be able to withstand a strain of 0.001 in/in. The glass lining should also be free of pinholes, crazing, and fish scale and be able to withstand thermal shock of 350 F. Additional specifications which are related to the quality of casting and are not contained in any current specifications are recommended. Cast pipes with obvious flaws or roughness should not be lined and cast iron is recommended over ductile iron for glass lining. In terms of warpage, the finished glass lined pipe should not deviate more than 0.0125 inch/foot of length from a centerline perpendicular to the flange face or square end of the pipe.

B029

FEASIBILITY STUDY FOR A SEWAGE SYSTEM IN THE CITY OF BLANTYRE IN MALAWI (Feasibility-Studie fuer das Abwassersystem der Stadt Blantyre in Malawi),

Bucksteeg, K.

Wasser und Abwasser Bau-intern, No. 8, p 158-160, 1977. 2 fig.

Results are presented on a fact-finding mission in connection with a feasibility study concerning a modern sewage system in Blantyre, Malawi, a rapidly growing city with 165,000 inhabitants and expanding industry. Due to the orographic conditions, the city has three independent sewage systems with waste water treatment facilities for some 75,000 inhabitants. The existing biological waste water treatment plants are overloaded and poisoned by industrial effluents. A considerable and increasing portion of the inhabitants live in huts in areas unsuitable for canalization. The construction of a new sewage system was rejected in view of the high cost (10,000,000 DM). Training of the operating personnel and installation of a waste water laboratory were recommended.

B030
CAST-IN-PLACE PIPE USES TRENCH AS FORM,

The American City and County, Vol. 92, No. 11, p 59-60, November, 1977.

Cast-in-place concrete pipes have been recommended for fast construction at low cost in large diameter pipeline projects. The method is particularly suggested for situations where the soils are stable, no groundwater flows into the trench, a steady supply of ready-mix concrete is available, and where construction of several hundred feet of large diameter pipe is required. Current cast-in-place methods utilize both the sides and bottom of the pipe trench as the exterior form for the pipe to provide a strong bond between the pipe walls and trench. The Fullerform system, patented by Lomar Corporation of Santa Ana, California, has been used in the construction of low-pressure piping for irrigation and storm sewer lines. The continuous, jointless structure eliminates problems associated with joint leaks and reduces the chance of clogging. Cast-in-place pipe projects have generally been bid below the engineering estimates for reinforced concrete or metal pipe. Installation crews as small as four people have been used and backfill can be completed after 72 hours curing time. Cylindrical steel forms are used for the exterior of the pipe and a variation of the slipforming technique which requires a heavy fabric inflatable tube is used for the interior walls. An anchor truck equipped with a compressor and generator is used to emplace and inflate the slipformer while ready-mix concrete trucks feed concrete to the trench. Circular or square forms are used in pouring of the cast-in-place manholes.

B031
PIPEWORK FLEXIBILITY,

Bryce, R.

Chartered Mechanical Engineer, Vol. 24, No. 11, p 47-50, December, 1977. 1 fig.

A technique of structural analysis is presented for the examination of pipeline flexibility where deflections due to shear can be neglected. The pipe is aligned with respect to a system of right-hand coordinates and the displacements which occur when the pipe is subjected to external moments are examined. When the pipe is constrained to lie in a single plane, all deflections must lie in that plane and there is no torsional moment acting on the system. One end of the pipe is assumed fixed while the other is free to move under the action of external moments. Equations are presented for the displacement of the unfixed end due to the moment. Rotational parameters are incorporated into equations which describe the deflection of the complete pipe length. A three-plane system which allows for torsional effects is described. Components of displacement occurring at the unfixed end due to twisting and bending moments in the three-place system are defined for a three-section pipe. Angular rotations in the three-plane system are defined.

B032
THE TWIN-TUNNEL CONCEPT,

Civil Engineering, p 45, 47, November, 1977.

England's National Water Council Standing Committee on Sewers and Water Mains has examined several methods of sewer design and installation with respect to costs for operation and maintenance. The twin-tunnel design concept has been recommended for alleviating problems associated with inspection, cleaning, and renovation of larger-diameter sewers. Although twin tunnels provide hydraulic capacities equivalent to a single, larger diameter sewer, self-cleansing characteristics are increased by the overall reduced radius of the smaller line. Gates can be used to divert waste water flows to a single tunnel if demands are not exceptional, creating a flushing effect in the single tunnel. The ability to divert flows also aids in general maintenance operations. A lower ground cover and gradient are generally possible with the smaller, twin-tunnel design. Disposable linings can be incorporated into twin-tunnel designs to insure water-tightness and inhibit corrosion. Although capital costs may be higher than for a conventional large diameter system, a net overall savings can be realized through reduced maintenance and replacement requirements.

B033
GLASS REINFORCED CONCRETE PIPES,

Water and Waste Treatment, Vol. 20, No. 8. p 26, August, 1977.

"Slimline" glass reinforced concrete pipes are being produced commercially by ARC Concrete's factory at St. Ives, Cambridgeshire, in England. The pipes are reinforced with Pilkington's Cem-Fil glass fiber instead of the traditional steel and are useful in sewage treatment and surface water conveyance. The initial capacity of the factory was set at 10,000 tons/yr with allowances for later expansion via modular unit additions to increase the capacity to 50,000 tons/yr. The glass reinforced pipes are currently available in diameters of 600-1,200 mm. Current research at ARC Concrete is directed toward developing piping material which is resistant to attack by hydrogen sulfide or corrosive soils such as those which occur in the Middle East and other hot regions.

B034
$4.7 BILLION FOR SAO PAULO SEWERS MARKS INVESTMENT SHIFT BY BRAZIL,

Engineering News-Record, Vol. 199, No. 25, p 44, December, 1977. 1 fig.

Sao Paulo, Brazil, will soon begin to build its first comprehensive sewage collection and treatment system. Construction of the system will take place in stages and continue through the year 2000. Today, only 38% of Sao Paulo is served by sewers; and only 5% of the sewage receives primary treatment. The new system, when completed, will collect 90% of the sewage and subject it to secondary treatment. The 3300 mi collection system will be built by local contractors. The treatment equipment is to be purchased abroad. The state of Sao Paulo allocates over 40% of its total capital budget to public health and sanitation projects. Sewage comprises 25% of the flow of the River Tiete which ultimately empties into a reservoir providing part of Sao Paulo's drinking water supply. Treated water will enter the Tiete after 1983, when the first waste treatment plant is scheduled to begin operation. Activated sludge will be used, but new treatment technology will be incorporated wherever possible. Engenharia de Projetos, Ltda., a local firm, prepared the master plan. Technical advice was provided by: Metcalf and Eddy, Incorporated, Boston; experts from Capetown University in South Africa; the Thames Water Authority in England; and the Ruhr Valley Pollution Control agency in West Germany.

B035
INTERNATIONAL PIPE PROTECTION CONFERENCE,

Corrosion Prevention and Control, Vol. 24, No. 5, p 2-4, October, 1977.

Highlights of the International Pipe Protection Conference held in 1977 at the University of Kent in Canterbury, England, are presented. Coating materials, pipe linings, sewer protection, erosion control, and electrochemical aspects of corrosion were discussed. The development of a new sewer material, sulfur-concrete, prefaced a discussion of methods of protecting concrete pipes in hot climates from attack by sulfuric acid formed in septic sewage. Solutions proposed include epoxy or coal tar-epoxy linings and glass-reinforced cement. Structural and non-structural lining of water mains was considered. At present, structural renovation techniques are limited to polyethylene pipe insertions and spray application of fiber-reinforced cement. Various techniques of corrosion control for water treatment systems were presented.

B036
THE EFFECT OF TEMPERATURE CHANGE ON PLASTIC PIPE,

Demergian, H.

I. A. Naman and Associates,
Los Angeles, California.

Plumbing Engineer, Vol. 5, No. 6, p 27, 48-50, November-December, 1977. 3 fig, 1 tab, 6 ref.

Properties of expansion and contraction of plastic pipe are compared with those of metal pipe under variations in temperature. When polyvinyl chloride (PVC) pipe is subjected to the same change in temperature as an equal length of steel pipe, the PVC pipe is five times more flexible than the steel under unobstructed conditions. Under rigid installation conditions, the PVC pipe is subject to less stress under thermal variations than the steel pipe. Piping installation should allow for combined stresses related to internal and external pressure, temperature changes, and the pipes' weight. Thermal contraction can be compensated for by snaking the pipe during installation. For rigid pipe, expansion joints or loops and changes in direction can be used. When expansion is anticipated, straight installation of plastic pipe can compensate for the thermal increase and consequent expansion. Thermal expansion coefficients are calculated for a number of other metal and plastic pipes.

B037
CAN TRENCH CAVE-IN DEATHS BE CUT?,

Civil Engineering-ASCE, Vol. 47, No. 7, p. 82-86, 1977. 1 ref.

Approximately 100 construction workers die annually because of trench cave-ins, primarily in sewer lines 5 to 20 feet deep. Most of these occur in excavations which are unshored. Careful study of the soils through which the trench will be cut and adequate engineering design are recommended. The major factor contributing to the high number of cave-ins is the lack of adequate engineering design and preplanning. Engineers should determine the nature of the soils to be encountered and design and specify the temporary support systems. Jurisdictions requiring that trench shoring be engineer-designed are noted. Thoughts from the insurance industry on trench cave-ins are presented. It is suggested that post-cave-in analyses of trench soil be conducted in efforts to learn as much as possible from actual accident scenes.

B038
FIXED-GRID CHARACTERISTIC FOR PIPELINE TRANSIENTS,

Wiggert, D. C., and Sundquist, M. J.

Michigan State University,
East Lansing,
Department of Civil Engineering.

Journal of the Hydraulics Division-ASCE, Vol. 103, No. HY12, p 1403-1416,
December, 1977. 8 fig, 8 ref, 1 append.

A method for the prediction of pipeline transients in closed waste water lines which involves the use of a general linear interpolation in conjunction with the method of characteristics technique and a rectangular grid has been developed. The variations of numerical attenuation and dispersion with respect to interpolation, spacing, and grid size were calculated through error analysis. The error analysis indicated that maximization of both the interpolation parameters and the number of spacial intervals for interpolation effectively reduced the numerical attenuation and dispersion. Results also showed that interpolation paramaters should be maintained near unity and the number of spatial intervals for interpolation increased to more than one when applied to systems with constant wave speed and no friction factors. The method of characteristics interpolation technique was used to predict pipeline transients in hypothetical systems under conditions of constant wave speed, variable wave speed, and severe wave speed fluctuations.

B039
SEWERAGE IN RURAL AREAS,

Bishop, G., and Kirby, T. H.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 4, p 423-436, 1977. 5 fig, 2 tab, 7 ref.

Guidelines for the selection and installation of sewage systems in rural areas are presented. The study emphasizes the need to consider the geographical location and the type of usage a sewage system will encounter. Sewers are usually installed to accomodate both the natural fall of the land and the best route to an outfall or treatment plant. The study suggests that, in rural areas, lines should also be placed beneath the roads whenever possible. Consideration of depth of sewer lines and the number of pumping stations is recommended in flat areas. In order to prevent the growth of bacterial slime in the pipe, it is suggested that pipe size be selected to provide a minimum flow velocity of 0.75 m/sec. Automatic and reliable pumping stations are recommended for fewer repairs and lower maintenance requirements. A submersible pumping plant, where feasible, can be economically attractive. Rising mains with a minimum velocity of 0.75 m/sec are recommended for pumping sewage. Methods to prevent hydrogen sulfide production in rising mains are also discussed.

B040
NEW PORTOBELLO OUTFALL, BRIGHTON,

Water Services, Vol. 81, No. 982, p 764-766, December, 1977. 2 fig.

A new outfall tunnel for the discharge of sewage effluents into the ocean has been constructed for the boroughs of Brighton and Hove in England. The outfall, whose construction began in 1971, was commissioned as a replacement for an outfall constructed in 1928 that had an average daily flow of 680 liters/sec. The new system has a daily flow capacity of 6800 liters/sec with an internal diameter of 2.13 meters. The outfall tunnel, which is 1830 meters long, is fitted with a diffuser system containing nine shafts, each with a four-part diffuser head. A new pumping station was completed in 1975 to treat the influent. Solids are removed from the influent by coarse raked bar screens and fine mesh cup screens. Grit is removed before the effluent passes to the automatically controlled pump sets. Screened solids are dewatered, checked for magnetic content, and processed by a twin-screw press where the moisture content is reduced to 50-55%. The pumping system is capable of discharging effluent during all tidal stages, with the outfall designed to act as a pressure main. The treatment and outflow plant was built near chalk cliffs which were below the water table. Construction problems were overcome by the installation of a system of sand/cement grout curtain walls and a base plug to solidify the fissured chalk and control the water inflow.

B041

GROUND PROBLEMS OVERCOME ON CRAWLEY SEWER JOB,

Surveyor, Vol. 150, No. 4452, p 15, October, 1977.

A support system for excavation site walls has been developed by Shorco Trench Systems Ltd of Leeds, England. The Escon box system has been used in sewer construction projects where the ground is unstable or saturated and where the soil lacks cohesion. The Escon box consists of steel side supports connected with braces and shock absorbing equipment. The modular assembly has sharp bottom edges for ease of installation. The supports are 3.4-m long by 2.6-m high and the system has an expandable width from 0.9-4.5 m. The support system prevents erosion of the trench walls where seepage pressures or soil properties cause unstable conditions. Additional supports can be added to the shoring system in 1.3-m sections where excavation depths exceed the height of the support walls. The system has been used for a sewer installation project in Crawley, England.

B042

TOXIC WASTE DUMPING INCIDENT DEMONSTRATES SURVEILLANCE NEEDS,

Public Works, Vol. 108, No. 12, p 58-60, 82, 83, December, 1977. 1 fig, 1 tab.

Unauthorized dumping of highly toxic waste into a combined sewer by a Memphis, Tennessee, chemical manufacturing plant created serious problems for government entities in six states during March 1976. The chemical wastes, which had entered the collection system of the Louisville and Jefferson County Metropolitan Sewer District in Kentucky, resulted in the need for total by-passing to the Ohio River of sewage normally treated at the Morris Forman waste water treatment plant. The toxic compounds were identified as hexachlorocyclopentadiene and octachlorocyclopentadiene. Water treatment plants downstream at Evansville, Indiana, and at Henderson, Kentucky, were able to remove the toxins using Aqua Nuchar activated carbon obtained from the Chemical Division of Westvaco. Mount Vernon, Indiana, was forced, however, to ban usage of all drinking water. As a result of the dumping incident, some 24,000 ft of sewers in the northwestern Louisville area contained contaminated sludge. Preliminary tests had indicated that the wet air oxidation process developed by Zimpro Inc of Rothschild, Wisconsin, could effectively degrade the compounds into less toxic substances. Full-scale processing of the six million gallons of contaminated sludge was then initiated. Daily monitoring at waste water treatment plants with the use of on-site gas chromatograph scans to detect volatile organics was recommended to prevent reoccurrence of the dumping incident.

B043

PROTECTION OF UNDERGROUND WATER MAINS AGAINST CORROSION,

Shidhaye, V. M.

Municipal Corporation,
Bombay, India.

Journal of the Institution of Engineers (India), Vol. 57, Part CH 3, p 127-133, June, 1977. 4 tab, 6 ref.

Various aspects of the protection of underground pipelines against corrosion are discussed. The collection of preliminary data on soil properties, the behavior of existing pipelines, and soil resistivity is recommended before large diameter pipelines are emplaced. Various coating materials have been used to segregate the pipe surface from corrosive soils or water. The chemical resistance, resistance to water absorption, electrical resistance, mechanical strength, ease of application, durability, and curing time are compared for various coating materials, including: gunite, coal tar enamel, fiberglass wrap, blown asphalt, plastic tape, and impregnated hessian. Coal tar coatings are recommended for areas characterized by a high water table or saturated soil conditions. Polyethylene sleeving is recommended for use in aggressive soils.

B044

ACCUMULATION OF SLIME IN DRAINAGE PIPES AND THEIR EFFECT ON FLOW RESISTANCE,

Bland, C. E. G., Bayley, R. W., and Thomas, E. V.

Clay Pipe Development Association Limited,
London, England.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 134-143, January, 1978. 4 fig, 8 tab, 10 ref.

The effects of microbiological slime accumulation in drainage pipes on hydraulic roughness and flow resistance were analyzed in laboratory experiments with three types of pipe interior surface finishes and six pipe materials. In a previous experiment, the hydraulic roughness of 100 mm unglazed, salt-glazed, and ceramic-glazed pipes was 0.023, 0.030, and 0.006, respectively. The six pipes used in the experiment with waste water had a 100 mm bore and were 0.30 meters long. They were constructed of unplasticized polyvinyl chloride, asbestos cement, pitch fiber, unglazed clay, ceramic-glazed clay, or salt-glazed clay. Slime accumulation was found to be partially dependent upon inclination of the pipe and contact time with waste water. Tests conducted under free flow conditions running at half capacity of the pipes demonstrated that slime accumulation was independent of the pipe construction material but highly influenced by waste water velocity. Dry material accumulations up to 0.7 kg/square meter were observed for velocities of 0.5 meter/second, whereas accumulations of 0.05 kg/meter resulted for velocities of 2.4 meters/second. Waste water velocity was also found to be a function of hydraulic resistance under pressurized flow conditions. Hydraulic roughnesses of more than 14.0 mm were observed for velocities of 0.76 meter/second. Again, pipe construction material was not an important factor in slime accumulation and hydraulic resistance under pressurized flow.

B045
DESIGN OF AN OUTFALL,

Grant, F. A., Chao, J. L., and Hennessy, P. V.

James M. Montgomery, Consulting Engineers, Incorporated,
Pasadena, California.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 347-361, February, 1978. 10 fig, 3 tab, 18 ref.

An ocean outfall was designed for the cities near Humboldt Bay, California, with specific attention to wave forces, ocean bottom velocities, ocean floor sediment composition and topography, seasonal irregularities, and outfall construction materials. The pipeline design was a compromise between a fully articulated pipe with ball joints and a totally static buried or pile-supported pipe. The pipeline was constructed of flexible, coated steel and supported by sheet piling within the first 2,000 ft from shore with ball joints joining the sheet piling to the diffuser. The diffuser, maintained above the ocean floor in a wave breaking zone, was anchored with ballast rock ranging 1.5-2.0 ft in diameter. Protection against cathodic corrosion was provided by a sacrificial zinc anode system. The outfall, which was located between two pulp mill outfalls discharging log-bearing debris, was protected from physical damage by minimum burial. The final outfall pipe design included five ball joints at 200-ft intervals, two joints near the trunkline rock foundation, and a diffuser wall thickness of 1.5 inches to resist corrosion. The outfall was designed to last at least 50 years.

B046
USE OF MIXING PIPES TO IMPROVE THE FLOW OF WASTE WATER INTO LAKES (Einsatz von Mischrohren zur Verbesserung der Einleitung von Abwasser in Seen),

Hofer, K., Hutter, K., and Vischer, D.

Versuchanstalt fuer Wasserbau, Hydrologie und Glaziologie an der ETHZ,
Zurich, Switzerland.

Gas-Wasser-Abwasser, Vol. 57, No. 12, p 846-852, 1977. 9 fig, 1 tab, 11 ref.

Methods of reducing the height of rise and increasing the overall dilution of purified waste water discharged into lakes are evaluated. The reduction in the height of rise is considered necessary to prevent the acceleration of biosynthetic processes by the high levels of phosphorus in the waste water. Diffusers based on the water jet pump principle are considered suitable, depending on the degree of stratification of the lake water. For a nonstratified lake, diffusers having a diffuser diameter to nozzle diameter ratio greater than 1.86 are required to improve the degree of mixing. Advantages afforded by premixing are greater with lower Froude numbers and stratification parameters and with an increase in the diffuser to nozzle diameter ratio. Modifications in the nozzle design can be used to economically and efficiently adjust the discharge cross-section and the Froude number with respect to variations in the waste water discharge.

B047
FLOW ATTENUATION IN SEWERS,

Stephenson, D.

Witwatersrand University,
Pretoria, South Africa,
Department of Hydraulic Engineering.

Public Health Engineer, Vol. 5, No. 6, p 157-159, 1977. 1 fig, 8 ref.

A mathematical model was developed for the cost-effective estimation of flow attenuation in storm water and sewage drains and for the calculation of water quality and velocity required to flush these drains. Flow attenuation studies are often designed for steady state conditions. Steady state friction equations developed by Mannings, Chezy, and Darcy were employed. Short duration inflow waves were found to decrease in depth, elongation and flattening as they move down the conduit. Equations are presented to explain the mechanics of irregular flow in a partially full, circular conduit. Velocities, inflow rate, duration, conduit length, bed slope, diameter, friction factor, and base flow are considered as variables in the equations. A graph depicting the attenuation in depth of the surge was developed for calculating minimum drain diameters for storm routeing, end capacities after routeing, and the flow required to scour deposits accumulated on the interior sewer walls. Flow rates in conduits were maximized by the addition of storm water inflows along the length of the pipe.

B048

NEW SHALLOW SEWER BEATS HIGH COST OF DEEP GRAVITY SYSTEM,

Hancock, N.

Engineering and Contract Record, Vol. 91, No. 1, p 20-21, January, 1978.
1 fig.

A shallow depth sewage system which includes polyethylene pipes and grinder pumps has been installed in the Canadian Toronto Islands. Special construction techniques were required because of the area's high water table, flat terrain, and permafrost. Polyethylene pipe sections, up to 300 feet in length, were joined with a butt fuser machine and insulated with 2 inches of water repellant styrofoam. The pipes were buried beneath three feet of covering to guard against frost. The manholes were also insulated with 2 inches of styrofoam; chamber valves and piping were wrapped with styrofoam half-shells and polyethylene tape. The 28,000 feet of pipe serves the year-round system and the summer recreational facilities. The system contains 30 pumping stations with 125 gal/min centrifugal grinder pumps serving the larger usage areas. Three pumps, one 75 hp for summer use, one 10 hp for winter months, and one backup pump, are employed in the system. Sewage is eventually discharged into the Toronto interceptor sewer.

B049

SEWER STRATEGIES FOR THE DALES AND THE FENS,

Surveyor, Vol. 151, No. 4465, p 14, January, 1978.

Sewage system overloads in West Yorkshire and Spalding, England, have been eliminated through the construction of new sewage treatment facilities. Sewage overflows in the Denby Dale area of Yorkshire had caused flooding of a gummed paper manufacturing plant several times a year. The Clayton West treatment works, with a design capacity of 1022 cu m/day and an actual flow of 2200 cu m/day, will be enlarged to a capacity of 5500 cu m/day. Sewers will be relaid to prevent infiltration and flooding. The overloaded treatment works at Spalding will be replaced by a new sewage treatment facility. Flooding was primarily caused by the unreliable storm water pumping system of the old works. The new treatment facility will provide partial sewage treatment before effluent is discharged into the River Welland. The new pumping system will include individual rising mains in each pumping station; all uncontrolled storm flows are now being handled by two storm drains.

B050
UPDATING AND COMPLETING SEWER RECORDS COULD COST LESS THAN YOU THINK,

Surveyor, Vol. 151, No. 4465, p C1, January, 1978. 1 fig.

A survey of all manholes, sewer lines, and outfalls in the London Borough of Waltham Forest in England was completed within two years at a substantial savings. The first phase of the project involved visual inspection of all manholes, conduits, and outfalls in the three divisions of the borough. The second phase of the survey required a study of existing sewer records which outlined some of the routes of old sewer lines not located along public highways. Each manhole was examined for pipe size, depths, and structural defects; precise locations of sewer lines were identified with electroprobe equipment. The electroprobe survey detailed the location of old sewer lines constructed on curves or sharp bends. A total of 10,786 manholes, 372 lampholes, and 213 outfalls were investigated in the survey. The final cost of the project, which was estimated at 50,000 pounds sterling, was 29,000 pounds sterling after the collation of the survey data.

B051
A DYNAMIC STUDY OF WATERWORKS PIPING UNDER EARTHQUAKE SHOCKS,

Otsuki, H., Nakamichi, Y., and Kawasaki, K.

Journal of Japan Water Works Association, No. 517, p 2-18, October, 1977.
30 fig, 6 tab, 28 ref.

The impact of earthquake tremors on various types of underground pipe conduits for water transport was examined within the context of theoretical pipe dynamics. Subsurface conduits extend along the ground surface and are encased in sand and soil. The seismic force of an earthquake acting on basement causes shearing as surface waves move over the superficial base. The resulting ground deformation causes similar deformation and stress in the conduit body. The stress resulting from the seismic force and ground deformation is distributed over various parts of the pipe. The earthquake tremor causes the ground to vibrate, initiating a parallel vibration of the underground conduit. This sympathetic response to the seismic vibration of the ground occurs in all underground conduits.

B052
MEASURING PRESSURE SURGES IN PIPELINES,

Water and Waste Treatment, Vol. 20, No. 10, p 26, October, 1977. 2 fig.

Transducers (CEL) of Reading, England, has developed a bonded strain gauge pressure transducer for the measurement of pressure surges in pipelines. The Water Research Center in Medmenham, Bucks, England, used the transducer to measure pipeline surges in an attempt to prevent pressure-related pipeline damages. The DataSense 1000, capable of optimizing pump switching timing or measuring static or dynamic pressures in pipes, was modified from 0-500 lbs/sq in to 0-1.5 lbs/sq in and 0-375 lbs/sq in. The transducer was used in conjunction with a portable pressure indicator and a chart recorder. An isolating valve with an integral bleed value was positioned in the pipeline to be tested. Air trapped in the pipeline was released by the bleed valve which was then shut. The isolating valve was then opened and the pressure was measured. Positioning of the transducer is dependent upon the type of pipeline being measured.

B053
PIPELINE FLOATED ACROSS RIVER,

Water and Wastes Engineering, Vol. 15, No. 1, p 32, January, 1978.

A prestressed concrete sewer main, connecting the York County, Virginia, treatment facility with a large southern treatment plant, was settled into position in Virginia's Poquoson River. The sewer line, with a diameter of 42 inches, is part of a sewer force main encompassing over 30,000 ft of 42 and 30 inch pipes. The main was constructed with movable ball joints, allowing flexible conformity of up to 15 degrees to the river bed. As the pipe sections were joined, they were floated across the river by a cable from the opposite shore. A wooden pile bridge was constructed parallel to the line to provide a support structure for seven cranes which aided in the installation. Filling in of the trench, excavated on the river bottom for the sewer main, was prevented in a marshy portion of the shore by steel sheet pilings. Once the pipe was floated across the river, it was settled by pumping of water through the line.

B054
DIRTY "OLE MAN RIVER" GETTING CLEANED UP,

Water and Wastes Engineering, Vol. 15, No. 1, p 44, January, 1978.

A $2.8 million interceptor sewer and pumping station for the President's Island section of Memphis, Tennessee, has a maximum daily flow capacity of 21 million gallons of municipal and industrial wastes. The interceptor sewer consists of four miles of gravity sewer line and two miles of force main, 2000 linear feet of which was submerged into place in a channel of the Mississippi River. The larger concrete gravity sewer lines, with diameters ranging 12-42 inches, were lined with coal tar epoxy to prevent hydrochloric acid corrosion. The force main lines, with diameters of 4-30 inches, are supplemented by four lift stations in areas of deep pipe excavation. The President's Island pumping station is equipped with two variable speed and two constant speed pumps with capacities of 4,900 gal/min. The pumping station wet wells are designed to transform stress into compression, reducing the need for thick walls. The pumping station will ultimately discharge the effluent into a waste water treatment facility in Memphis.

B055
NEW PORTOBELLO OUTFALL,

Water and Waste Treatment, Vol. 20, No. 12, p 28-31, December, 1977. 3 fig.

A new outfall constructed at the Portobello cliffs in England has a dry weather flow capacity of 6,800 liters/sec, a discharge rate 10 times that of the 1928 outfall is replaces. The outfall tunnel has a diameter of 3.4 m and a length of 1,830 m and will discharge treated effluent through a diffuser at a low tide ocean depth of 14.4 m. The shaft from the pumping station to the outfall tunnel was laid in water-bearing chalk which required manual excavation and peripheral ring grouting around the outside of the shaft for support. A nine shaft diffuser system with four port diffuser heads mounted on each shaft was installed on the last 347 m of the outfall. Waste water is treated at the pumping station which combines mesh cup screens, grit dredging, and solids dewatering and pressing. Preparation of the pumping station site in the chalk cliff was required before construction of the foundation. The final cost of the project was estimated at 3.7 million pounds sterling.

B056
PIPEFREEZING A SEWER,

Water Services, Vol. 81, No. 982, p 778, December, 1977.

Liquid nitrogen was used by BCB Pipefreezing Services Ltd of Croydon, England, to freeze a section of a sewer main that had to be rerouted. The 250 mm diameter pipeline, which carries sewage from the town of Brookend to a pumping station, was rerouted for the installation of a 4 by 8 ft concrete culvert at the same depth as that of the sewage main. A section of the pipe, constructed of spun cast iron, was isolated with insulated freezing jackets into which liquid nitrogen was injected. Freezing of the pipeline eliminated the necessity of draining the several mile long sewage main and shutting down the pumping station while the pipe was rerouted. Once the main was adequately frozen, the section of pipe was removed and the modifications were completed.

B057
A TOUGH CONTENDER FOR PIPEWORK? SIMPLE AS ABS,

Maitland, J.

Process Engineering, p 107, 109, 111, October, 1977. 2 fig, 2 tab.

Acrylonitrile butadiene styrene (ABS) plastic is replacing lead, copper, cast iron, and steel as the preferred material for drain, waste, and vent pipes. The ABS plastic has superior heat resistance and greater ductility at low temperatures than polyvinyl chloride pipes. The absence of noxious combustion products is an additional advantage of ABS pipes. Industrial uses of ABS material include the transport of chemicals, slurries, effluents, and compressed air, as well as mine and quarry applications. Food and water supplies can be transported through this material because of its nontoxicity. A newer use of ABS is for pipe castings; installations to a depth of 600 ft have been achieved. ABS offers light weight, a high modulus, abuse resistance, heat resistance, and suitability for potable water. The quality of ABS is dependent upon the processing and the use of high molecular weight ABS resin. ABS pipes, with solvent welded or rubber joints, are resistant to low levels of radiation in nuclear power stations.

B058

THE DEVELOPMENT, MANUFACTURE AND APPLICATIONS OF GLASS REINFORCED PLASTIC PIPES,

Cooper, L. T.

Anti-Corrosion Methods and Materials, Vol. 25, No. 2, p 3, 5, 7, 10, February, 1978. 1 tab, 6 ref.

The development, manufacture, applications, and costs of glass reinforced plastic pipes are reviewed. The longitudinal and circumferential strengths of pipes are reinforced with biaxial or helical winding of resin-impregnated glass fiber. In the Redland Pipes Ltd plant in Parkstone, England, a biaxial winding machine is employed for the pipes with diameters of 300-2,000 mm, and a combined helical and biaxial machine for pipes having diameters of 300-4,800 mm. Glass reinforced plastic pipe has a strength to weight ratio seven times that of steel; it is light weight, corrosion resistant, abrasion resistant, and non-toxic and not resistant to flow. The ability of glass reinforced plastic pipe to withstand heavy loads and corrosives makes it suitable for sewage and drainage installations. The plastic pipes are capable of resisting the high and low internal pressures experienced in rising mains and pressure pipelines; its resistance to tainting, toxins, and microbial growth makes it suitable for potable water conveyance. The cost of glass-reinforced plastic pipe is less than that of polypropylene, polyvinyl chloride, and stainless steel pipe. Plastic pipe is cost competitive with mild steel pipes in the larger diameter ranges.

B059

MODIFYING MANNING'S EQUATION FOR FLOW RATE ESTIMATES,

Lanfear, K. J., and Coll, J. J.

Water and Sewage Works, Vol. 125, No. 3, p 68-69, March, 1978. 3 fig, 2 tab.

A modification of Manning's equation is developed to reduce the error of flow calculation in municipal sewage pipes and manholes and to eliminate the need for measuring slope. Estimation of the Manning's coefficient can lead to a 15% error in the calculated flow rates. The measurement of slope in old, deteriorated, or defective pipes is not always accurate enough to provide accurate flow data. Manning's equation also does not take into account the variation of the Manning's coefficient with the depth of flow. The modification of Manning's equation involves determining the function of slope with a single flow measurement. The slope function is calculated according to measured values of velocity, area, hydraulic radius, pipe diameter, and depth of flow. Flow rates in several manholes are measured with a velocity meter used in conjunction with depth of flow, the modified Manning's equations, and the conventional Manning's equation. Flow rates calculated by the modified Manning's equation agreed with measured values obtained in three manhole tests. Flow rates calculated according to the conventional Manning's equation agreed with the measured flow rate in only one instance, overestimating or underestimating flow rate in the other two tests.

B060

BURIED FLEXIBLE PIPE PERFORMANCE IN THE PROXIMITY OF NEW EXCAVATIONS,

Nesbeitt, W. D.

Public Works, Vol. 109, No, 3, p 80-81, March, 1978. 2 fig.

Precautions for excavating in the vicinity of buried flexible pipe are reviewed and equations for calculating critical trench depth and safe separation distance are presented. The safe separation distance is a function of pipe diameter, depth of soil cover over the pipe, and the critical trench depth in a vertical excavation. The minimum safe separation for a highly flexible pipe is equal to the least amount of horizontal soil cover required between the pipe and the open trench to prevent shift or collapse of the trench wall. The critical trench depth is calculated with estimated values for soil cohesion, unit weight of the soil, and the friction angle of the trench wall soil. When the minimum safe horizontal separation is not established, a soil wedge may form by deterioration of the flexible pipe support, pushing into the open trench. The effect of soil failure upon the flexible pipe is related to the weight of the soil wedge, the stiffness of the pipe ring, and the failure arc of the soil shear plane. Pipe flexibility is considered a minor factor in estimating the response of buried pipe to adjacent excavation.

B061
OPTIMIZATION IN DESIGN OF PUMPING SYSTEMS,

Deb, A. K.

Roy F. Weston, Incorporated,
West Chester, Pennsylvania.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE1, p 127-136, February, 1978. 2 fig, 1 tab, 6 ref, 1 append.

A mathematical model for pipe diameter optimization in a pumping system incorporated capital costs, inflation factors, operation and maintenance expenses, and energy costs. Parameters considered for optimum pumping system planning included demand rate, installation timing, locality of use, salvage value, equipment life, head loss, viscosity, and liquid density. Energy requirements were higher for small diameter pipes which caused large friction heads and required for larger pumps. Large diameter pipes reduced energy costs but increased pipeline cost factors. The capital cost of a pipeline system was expressed as a function of pipe diameter or as a function of flow and total head. For systems where population growth and resulting increased demands on a pumping system could be anticipated, a formula was presented for selecting the optimum year for pumping system expansion on the basis of an inflation factor, a demand factor, and the length of the planning period.

B062
STANDBY POWER,

Water Services, Vol. 81, No. 982, p 770, December, 1977.

Standby power generators, produced by Auto Diesels Braby Ltd of Uxbridge, Middlesex, England, supply backup power during electrical failures to pumping stations within England's Regional Water Authorities. The compact generators, both installed and mobile, provide power outputs of 20-480 kilovolts-ampere. The units can be set for either manual or automatic control, the latter especially important in unmanned pumping stations where power failure could mean immediate flooding. The automatically controlled generators supply power to the pumping station within 20 sec of the main power failure. In pumping stations where power loss does not pose an immediate threat of flooding, mobile generators are transported to the pumping site. The mobile units provide the highest expected initial current required at the serviced pumping stations; the installed standby generators are programmed to provide the specific starting current required by the individual pumping station. The static generator is hooked into the main distribution switchboard at the station; the mobile generator is equipped with a control panel mounted on its own trailer.

B063
PIPING MATERIALS: LITTLE FUROR; SOME CHANGE,

Domestic Engineering, Vol. 231, No. 3, p 64-67, March, 1978. 2 tab.

Results of the 1978 Domestic Engineering Plumbing Code Survey on the permitted uses of various pipe types and materials were discussed. The survey was conducted for polyvinyl chloride pipe, polybutylene and polypropylene pipe, acrylonitrile-butadiene-styrene pipe, bituminous fiber, and cast iron pipe. The percentage of surveyed municipalities allowing plastic house sewer lines were: 59% for acrylonitrile-butadiene-styrene, 58% for schedule 40 polyvinyl chloride, 54% for D-3034 polyvinyl chloride, and 47% for bituminous fiber. Other uses allowed for the pipes surveyed included: house-street water lines, hot-cold water lines, single family homes, apartments, and commercial buildings. Of the 42 municipalities responding to the survey, 30 prohibited the use of polybutylene for hot-cold water lines. Chlorinated polyvinyl chloride was not allowed for hot-cold water lines by 23 of the cities; 27 prohibited the use of bituminous fiber pipes. Of the pipes surveyed, polyvinyl chloride and acrylonitrile-butadiene-styrene were allowed for above ground use by 21 and 20 of those responding, respectively. Cast iron soil pipe was sanctioned for all uses by all those responding except four.

B064
COTTAGE FARM COMBINED SEWER DETENTION AND CHLORINATION STATION, CAMBRIDGE, MASSACHUSETTS,

1977. 115 p, 24 fig, 22 tab, 5 ref, 5 append. Technical Report EPA-600/2-77-046.

The performance of the Cottage Farm Detention and Chlorination Station, Cambridge, Massachusetts, was evaluated during its initial 3 yrs of operation during periods of combined sewer overflows from the Charles River Valley sewer systems. The station, with a peak flow capacity of 233.1 mgd, diverts and treats combined sewer flows that exceed the capacity of the Deer Island Treatment Plant. Six detention tanks with a capacity of 1.2 million gal and a wet well holding up to 0.1 million gal contain the overflows; waste water flows up to the 5 yr design storm capacity are screened, skimmed, settled, chlorinated, and discharged to the Deer Island treatment facility when downstream flows subside. The Cottage Farm Station removed 45% of the suspended solids, 99.9% of the coliform bacteria, 69% of the settleable solids, and 42% of the BOD load. During the first three years of operation, the station completely contained 32 of the 114 overflows; overflows not completely detained by the Cottage Farm station were treated with a sodium hypochlorite solution before discharge to the Charles River Basin. Based on an estimated 33 overflows each year, the Cottage Farm station would be available 300 days of the year for other purposes, such as treatment of the Charles River water.

B065

DEMONSTRATION OF VOID SPACE STORAGE WITH TREATMENT AND FLOW REGULATION,

1976. 125 p, 30 fig, 11 tab, 22 ref, 4 append. Technical Report EPA-600/2-76-272.

An underground void space storage tank constructed in Akron, Ohio, was evaluated for collecting combined sewer flows during storm water overflows. The storage tank was an excavated basin lined with an impermeable membrane. The tank was filled with stones and had a capacity of 1 million gal in the void space of the inert media. Flows in excess of the tank storage capacity were chlorinated before they were discharged to the receiving waters. The retained waste water was discharged to the treatment facility during nonpeak hours of low flow. The storage tank received waste water by gravity flow from a 188.5 acre sewer drainage area. Chlorination of the stored waste water, containing primarily inorganic suspended solids, prevented the effluent from becoming septic. Assuming 10 capacity flows per year and retention of all suspended solids, it was estimated that 65% of the original void space volume would remain after 25 years of operation. The top layer of the storage tank could be developed for recreational purposes, providing a dual function of the system.

B066

ASBESTOS-CEMENT PIPES FOR OUTFALL SEWER,

Pipes and Pipelines International, Vol. 22, No. 5, p 33, October, 1977.

The installation of an outfall sewer constructed of asbestos-cement pipes, manufactured by TAC Construction Materials Ltd is described. The final outfall sewer designed for Peterborough Eastern, included four miles of Turnall and Everite asbestos-cement pipes. Pipe diameters ranged 500-900 mm; transportation of the pipes to the outfall sewer site was completed within a seven day period so that pipes could be joined before installation. The location of the rising main was calculated by a laser beam which was directed over the pipe crowns. The rising main was constructed of 500 mm diameter pipe which did not require a jointing tackle for connection. A trench safety shield was employed during installation of the 5 m long, 900 mm diameter pipes rather than shuttering because of excessive groundwater below the 4 m excavation depth.

B067

GRP PIPE FOR SEWAGE DISCHARGE AT SEA,

Pipes and Pipelines International, Vol. 22, No. 5, p 31-32, October, 1977.

Fiberglass-reinforced plastic pipes were used to construct a 1,507 m underwater municipal sewage outfall pipeline in La Pointe Simon, Martinique. The 9 mm thick pipes were reinforced with filament wound fiberglass. One hundred meter sections, each with a 609 m diameter, were connected on shore with glued bell and spigot joints and towed into position. The sections of pipe were tested at hydrostatic pressures of 2-3 bars before and after installation. The complete project required 10 workers, 7 months, and half the estimated cost for steel pipelines. Steel pipelines for the sewer outfall were rejected because of prohibitive installation costs, including: towing, welding, and protective linings. Cast iron pipe was rejected for its excessive weight and inflexibility. The fiberglass-reinforced plastic pipes are as strong and impervious as metal pipes.

B068
DUCTILE-IRON PIPE GALLERY,

Pipes and Pipelines International, Vol. 22, No. 2, p 10-11, April, 1977.

A waste water treatment plant, under the jurisdiction of England's Yorkshire Water Authority, utilizes ductile iron pipe protected beneath a gallery for the inlets and outlets to the sedimentation tanks. The horizontality of the area allowed the sedimentation tanks as well as other treatment units to be constructed above ground. The 3 m height of the water surface in the sedimentation tank allowed for the construction of a covered gallery to protect the ductile pipe sludge removal, effluent feed, and surface water pipes. The gallery also created a protected working area for the plant operators. The corrosion-resistant pipes included: flanged, flanged tapers, tee-junctions, and 90 degree bends. Specially-designed fiberglass-reinforced plastic ports to the sedimentation tanks diffuse the influent to enhance solids settling. A control station contains a porthole for sludge monitoring; electro-hydraulic actuators for desludging valves are push-button controlled from the gallery. The treatment facility is designed to treat wastes from a population of 58,000.

B069
LOCATING UNDERGROUND PIPES AT SEWAGE WORKS,

Pipes and Pipelines International, Vol. 22, No. 5, p 32, October, 1977.

Electrolocation Ltd has designed a GPR 404 sub-surface survey instrument for locating underground sewage pipes, cables, and drains. The device was used by England's Thames Water Authority to locate underground structures as part of a program to update records at the Hogsmill Sewage Treatment Works. The survey unit detects, traces, and plots the courses and depths of the sub-surface pipes and equipment. The instrument is equipped with aerials for detecting equipment in areas of high interference and locating manhole covers that have become buried. Plots of individual cables can be isolated from other cables that run alongside. The survey unit can be adapted to pick up the electric signals from underground cables, to induce a signal in dead cables or metal pipes, and to follow a probe that is fed through non-metallic conduits. The survey of the Hogsmill treatment plant was conducted as a prelude to future expansion of the 11.5 mgd facility.

B070
HISTORY OF SEWAGE PUMPING IN BRITAIN,

Stanbridge, H. H.

Water Pollution Control, Vol. 76, p 517-523, 1977. 67 ref.

The history of sewage pumping in England, from gravity flow to Archimedean screw pumps, was presented. Where gravity flow was not feasible, turbine-driven reciprocating pumps were used. Steam-driven beam engines to operate the pumps came into widespread use in the 1880's, followed by the smaller steam-driven reciprocating pumps in 1890. These were eventually powered by steam generated from refuse incinerator heat. Ram or plunger pumps were employed for transporting sewage at pumping stations, followed by pneumatic ejectors. Various sewage lift pumps were developed around the turn of the century, including: the Adams' sewage lift, patented in 1892; air-lift pumps; pulsometers; the patented Humphrey pumps; and a windmill-driven lifting pump. Internal combustion engines were replaced by electrically-powered pumps at the beginning of the century. Early centrifugal pumps were modified and improved to create the electrically-driven vertical-spindle centrifugal pumps. Electrically-powered axial-flow pumps, patented in 1927, and mixed-flow pumps were suitable for pumping large volumes of sewage against a low head. Archimedean screw pumps have been popular in this decade.

B071
HOSCAR'S EXTENSION SHOULD DEODORIZE THE DOUGLAS,

Appleton, B.

New Civil Engineer, p 18-19, January 12, 1978. 1 fig.

An 11.6 km-long trunk sewer was constructed to transport sewage from Pemberton, England, to the Hoscar biological filtration plant. The 1.85 m-diam concrete pipe required a steel shield for trench support and 5 km of wellpoints for soil dewatering during installation. The flow capacity of the trunk line was increased to 4.8 cu m/sec. Improvements at the Hoscar treatment plant are expected to increase the capacity to 1.8 cu m/sec by 1981 and improve the plant's treatment of industrial waste water. Activated sludge was unsuccessful in treating the filamentous bacteria in the effluent. Five hectares of biological filter beds were designed to incorporate vibroflotation and blast furnace slag. The Hoscar plant also contained circular humus tanks and pumping stations equipped with Archimedean screw pumps built on piled foundations. Because the sludge was unsuitable for land application, a 13.5 m-high multi-hearth incinerator equipped with stack gas scrubbers was selected for sludge disposal.

B072

PVC PIPE PASSES PERFORMANCE AND COST TESTS,

Lawless, E. J.

Water and Sewage Works, Vol. 124, No. 12, p 52-53, December, 1977.

The methods of installing flexible polyvinyl chloride pipe and pipe performance under stress and use are reviewed. For sewer conduit installations, polyvinyl chloride pipe requires proper bedding and backfill compaction. The pipe must be installed in a flat-bottomed, stable trench. For class 1 bedding materials, stone or gravel, the flexible pipe receives adequate side support without additional compaction; class 2 bedding, or sand, requires thorough tamping of the sides when backfill material from the trench excavation is used. Mandril testing for pipe deflection is required for trench excavations of 20-30 ft, where trench conditions are unstable, or where installation has been difficult. Deflection of the pipe after installation occurs within the first month, after which the pipe and soil conditions stabilize. Polyvinyl chloride pipe allows on-site cutting with a handsaw, easy tie-ins, and uncomplicated saddles for subsequent cut-ins. Although cleaning of the pipe is rarely necessary, hydraulic equipment or electric augers are efficient and do not damage the pipe.

B073

SEWER JET CLEANER THAWS WATER MAINS,

Public Works, Vol. 108, No. 12, p 61, December, 1977.

Frozen water mains in Janesville, Wisconsin, were thawed by jetting water at 42 F through the frozen pipe sections at a hydraulic pressure of 1,000 psi. A total of 8,000 feet of water main was cleared with the sewer cleaning equipment, supplied by Donahue and Associates of Sheboygan, Wisconsin. In sections where pipes, were completely frozen, excavation and cutting of the water main were required to introduce the water nozzle and hose. The nozzle, modified with a three-eighths inch hole in the tip, and the hose were driven through the pipes by the backward pressure of the jets. The pressure from the water jets forced the freed ice in the main back to the excavation areas. A total of 300 feet of water main had to be replaced because of freezing-related damage. The water jetting technique cleared an average of 16 ft of ice/hr as opposed to an estimated 1 ft/hr with steam melting. The entire thawing operation required 62 days and 20 employees.

B074
WASTEWATER EFFLUENT LINE SERVES DUAL PURPOSE,

Fowler, H., and MacLennan, R. G.

City Public Utilities Board,
Brownville, Texas.

Public Works, Vol. 109, No. 4, p 58-60, April, 1978. 2 fig.

A 2.7 mile-long pipeline transports treated effluent from the Brownville, Texas, waste water treatment plant and provides irrigation water for sorghum and cotton crops. The 36-inch diameter, low-pressure reinforced concrete pipe has a design capacity of 20 mgd and is capable of withstanding a pressure head of 60 ft of water. The treated effluent, with a BOD and suspended solids concentration of 20 mg/liter, is discharged through the pipeline to the Rio Grande River. The discharge point in the Rio Grande, which was moved 2.8 miles downstream from the original outfall to prevent contamination at a raw water intake station, contains a riprap system and a cofferdam. Three irrigation taps located along the pipeline supply more than 50% of the 1,000 gpm of effluent as supplementary irrigation water during dry periods. Due to the instability of the soil in which the pipeline was laid, cement-stabilized sand was used to backfill the installation site. The project cost $616,800 and was completed in 8 months.

B075
SEWERS . . . THE CLEANER, THE BETTER,

American City and County, Vol. 93, No. 4, p 43-44, 46, 48, April, 1978.

An evaluation of sewer cleaning techniques includes bucket machines, rodding equipment, high velocity water jets, hydraulic balls and hinged discs, plain flushing, chemicals, and bacteria. Bucket machines for removing all types of heavy debris require cables to connect the manholes. While the bucket units and porcupine brushes restore the hydraulic capacity of the sewer pipes, misalignment, broken pipe, or intruding laterals interfere with the cleaning operation. Flexible spring steel rotating rods provide adjustable driving speed and a variety of specialized attachments, but flexibility can provide a significant margin of inefficiency. The plastic or rubber hydraulic balls and hinged disc cleaning units operate on the hydraulic pressure of the waste water which is built up by blocking the downstream flow. The high velocity water jet which supplies a water source at 60 gpm at a pressure of 100 psi is a modification of this method. Inhibiting root growth in sewers is accomplished by introducing chemicals as fumigants or foams into a blocked sewer to retard root growth for several years. Plain flushing with fire hydrant hoses is effective primarily in flat areas and near the ends of sewer lines. Bacteria have been used more for cleaning of lift stations, filters, sludge digestors, and grease in treatment plants than in sewer lines.

B076
GROUTING PROVIDES ECONOMICAL AND EFFECTIVE MAINTENANCE IN KANSAS,

Penner, I. L.

Water and Sewage Works, Vol. 125, No. 3, p 66-67, March, 1978.

A program of chemical grouting and television inspection of leaks and defects in sewage pipes has been implemented in Wichita, Kansas. The 1,100 miles of sanitary sewers and 180 miles of storm sewers in Wichita are subject to damage by the extremes in temperature, precipitation, and soil conditions. Infiltration of the pipes, which were originally sealed with tar at the joints, was encountered in approximately 67% of the sewer system due to the dissolution of air bubbles in the tar seals after heavy precipitation. AM-9 chemical grout, manufactured by American Cyanamid Co, is applied to the interior of the leaking pipe joint with a pressure sleeve. The chemical grout forms a gel which seals the leak and stabilizes the surrounding soil. The setting time of the gel is controlled by the amount of catalyst added to the grout solution; the amount of grout required to repair a joint leak is calculated in a number of gallons equivalent to half the pipe diameter in inches. Once the grouting is accomplished, a four-person crew feeds the television into the sewer line to inspect the pipe repair. The grouted joints have been reported to withstand a variety of soil conditions, including quicksand. The total cost of grouting and inspecting a sewer joint is estimated to be $11.

B077
NATIONAL NEEDS FOR COMBINED SEWER OVERFLOW CONTROL,

Giggey, M. D., and Smith, W. G.

Metcalf and Eddy, Incorporated,
Boston, Massachusetts.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE2, p 351-366, April, 1978. 4 fig, 8 tab, 10 ref.

Costs and design efficiencies of eight hypothetical combined sewer overflow systems were analyzed according to American Public Works Association and EPA Needs Survey standards. Basic control and treatment objectives of combined sewer overflow with rainfall data as a factor were applied to characteristics of existing systems. Six of the hypothetical control systems treat combined sewer overflow and swirl concentrator underflow separately. The other two options store the overflow until the storm subsides and the waste water can be handled within the dry-weather capacity of the treatment facility. The first option provides disinfection without storage at a total cost of $13.046 billion. The second $54.360 billion option offers primary clarification and disinfection with in- and off-line storage. The third option, costing $68.400 billion, employs secondary treatment and disinfection with in- and off-line storage. Depending on the receiving water standards, the fourth option incorporates disinfection with or without primary treatment with in- and off-line storage at a cost of $34.200 billion. Similarly, the $62.380 billion fifth control option employs disinfection with primary or secondary treatment. The $25.073 billion sixth system, with off-line storage of underflow, uses swirl concentration with disinfection of overflow and discharge of underflow to existing treatment plants. The seventh system, costing $1.320 billion, provides in-line treatment of stored runoff at a treatment facility. The $6 billion option 8 provides the same treatment as system 7 with off-line storage of the 'first flush.' Total BOD and suspended solids capacities range over 310-660 and 450-2260 thousand tons/yr, respectively, for the eight combined sewer overflow control strategies.

B078
BORING MACHINES PICK UP SPEED ON DEEP CHICAGO SEWER TUNNELS,

Engineering News-Record, Vol. 200, No. 17, p 28-30, April, 1978. 1 fig.

Rotary moles up to 35 ft in diameter are being used to bore the 131 miles of deep tunnels and reservoirs to control storm and waste water overflows in Chicago, Illinois. The $2.8 billion tunnel and reservoir project for diverting and retaining overflows is part of a $5.6 billion plan to upgrade the sewers and waste water treatment facilities in Chicago. The rotary moles bore through limestone with compressive strengths up to 40,000 psi at depths to 240 ft. Grout is injected into the borings to control groundwater influx; the tunnels will be lined with 10-12 inches of concrete. The maximum capacity of the completed tunnels is estimated as 6 mgd. Rotary moles in the diameter range of 18-22 ft have maximum boring rates of 10 ft/hr with single disk cutters. Methods of removing the excavated rock from the tunnels, used by the various contractors, include: crane-lifted hoppers, conveyor bridge assemblies, and a 900 ton/hr conveyor in an inclined shaft. Problems have been posed in excavation by clay deposits which clog the mole cutters and curves. The electrical demands of the power head motors and the thrusting cylinders have been monitored as a means of effecting operation efficiency.

B079
BRIGHTON'S SEWAGE GOES TO SEA,

Surveyor, Vol. 150, No. 4456, p 8, November, 1977.

The 1,830 m long Portobello outfall has a design discharge capacity of 6,800 liters/sec for disposal of wastes from Brighton and Hove, England. The waste disposing tunnel, with an internal diameter of 2.13 m, discharges effluent to the English Channel through a diffuser located 14.4 m below the water surface. Waste water is transported from a pumping station to the outfall tunnel through a 3.4 m diameter shaft laid 44 m deep. The bolted segments of the shaft required peripheral ring grouting around the outside of the shaft to prepare the chalk cliff before installation. Influent reaching the pumping station is treated with coarse raked bar screens and fine mesh cup screens before discharge to the outfall. Screened solids and grit are passed through a pre-breaker, followed by dewatering to 50-55% moisture content in twin-screw presses. The outfall was assembled above water to eliminate the expense of compensating for high pressures at the 44 m water depth; air tools were required for excavating the chalk face of the cliff. The construction site was initially grouted until increasing deterioration was abated by lining the chalk with bolted cast iron rings. The outfall replaces a former structure that had a capacity of 680 liters/sec.

B080

DETERIORATING SEWER LINE RE-LINED IN ARIZONA,

Water and Wastes Engineering, Vol. 15, No. 2, p 27, February, 1978.

A clay tile sewer pipeline in Holbrook, Arizona, transporting municipal wastes to a treatment plant was relined with Phillips Products Co., Inc., 18-inch diam plastic pipe. The highly saturated clay and sandy soil beneath the 21-inch clay tile sewer connector had caused the pipe to sink. Initial attempts to stabilize the pipe bed with 5-ft of rock and concrete encasement were unsuccessful due to the high saturation of the former swamp drainage field. The 21-inch pipe was relined with 18-inch plastic pipe in 38-ft sections. The corrosion-resistant pipe lengths were butt fused and inserted into the existing sewer line. The joints prevent infiltration and exfiltration; the plastic pipe is resistant to mineral accumulation and retains its flow properties. The 710 ft of plastic pipe was assembled in two sections, 298 and 412 ft long, which were emplaced by a Caterpiller loader. The entire relining project was completed in two days by M. M. Sundt Construction.

B081

INTERCEPTOR NORTH COMPLETED AHEAD OF SCHEDULE,

Water and Pollution Control, Vol. 116, No. 1, p 17, January, 1978.

A 25,000 ft portion of the 5-mile sewer interceptor for Montreal, Canada, has been completed by the contractor, Beaver Foundations Ltd., 6 mos ahead of schedule and about $3 million under the original bid. Completion of the 90 city block stretch of sewer is expected by 1980. The tunnel was constructed 100 ft below the surface through four shafts sunk along the 25,000 ft length. Rock blasting was required and the tunnel was excavated from each shaft in the direction of the neighboring shaft. The 16-ft diameter horseshoe-shaped tunnel will intercept all municipal wastes from collector sewers and transport the sewage to a proposed treatment facility at the eastern tip of Montreal Island. The tunnel, which will circle Montreal Island, required 128,000 cu yds of concrete for the initial 25,000 ft section.

B082

A REVIEW OF THE HYDRAULICS OF GRAVITY DRAINAGE, WASTE AND VENT SYSTEMS,

Konen, T. P.

Stevens Institute of Technology,
Hoboken, New Jersey,
Building Technology Research Division, Davidson Laboratory.

Plumbing Engineer, Vol. 6, No. 2, p 11-15, March-April, 1978. 4 fig, 3 tab, 5 ref.

The hydraulic characteristics of drainage, waste, and vent systems in domestic sewerage are described. Water closets operate with an average daily water consumption of 100 gal, reaching a peak flow of 30 gpm; lavatories achieve a peak flow of 10 gpm over a discharge period of 12 seconds; and bathtubs rapidly reach a peak discharge of 12 gpm. Water flowing through a horizontal pipe, with constantly varying velocity and depth of flow, occupies half the pipe's capacity. Vertical drains or stacks maintain a rapid annular flow within a short distance from discharge. When the flow in a vertical pipe is transferred into a horizontal pipe, the decrease in velocity from 15 ft/sec to 2 ft/sec causes a hydraulic jump or an increase in depth of flow in the horizontal pipe. Relief vents and vent stacks alleviate the pressure at the base of the vertical stack. A comparison of surge durations in conventional and water saving toilets, as calculated by the ratio of volume and peak flow, indicates that a one-second difference in duration results in a 2% velocity difference between the systems. Velocity of discharge from a water closet is considered in calculating the depth of flow and velocity in primary and secondary branch pipes.

B083

PURIFICATION OF WASTE WATERS FOR SUBSOIL IRRIGATION (Ochistka stochnykh vod pri podpochvennom orochenii),

Shevtsov, N. M.

Gidrotekhnika i Melioratsiia, No. 2, p 44-48, 1978. 1 fig, 2 tab, 6 ref.

Treated waste water from a Russian village is used for subsurface irrigation of farmland by means of a gravitational distribution network of perforated irrigation pipes laid at a depth of 50-55 cm. After refuse, sand, and coarse suspended matter are separated mechanically, the sewage is settled for 2 hrs in two horizontal clarifiers. The treated sewage has a pH of 7.5-8.5, a dissolved solids content of 600-1,500 mg/liter, a suspended solids content of 200-300 mg/liter, a permanganate oxidizability of 274 mg/liter, and a bichromate oxidizability of 480 mg/liter. The waste water is then distributed through the irrigation network at a rate of 1-3 tons/ha/yr. Previous investigations have revealed that silting can reduce the free cross-section of the underground irrigation pipes by as much as 20-25% during the irrigation period. The organic matter is almost completely mineralized by the next irrigation period and the soluble components are washed out. This has resulted in a 4% net reduction in the free cross-section of the irrigation pipes over 8 yrs. These findings suggest that underground irrigation networks may have a lifespan as long as 50 yrs.

B084

RAINFALL ANALYSIS FOR THE DESIGN OF STORM SEWERS IN BOMBAY,

Chawathe, S. D., Shinde, U. R., Fadanvis, S. S., and Goel, V. V.

Associated Industrial Consultants,
Bombay, India.

Journal of the Institution of Engineers (India), Vol. 58, Part EN1, p 14-20, October, 1977. 1 fig, 9 tab, 5 ref.

Rainfall intensity, duration, and frequency relationships were examined for two sections of Bombay, India, over 24-33 yrs as a preliminary to designing and upgrading storm sewers. Rainfall data over 24 yrs in Colaba represented 1,349 storms; 33 yrs of rainfall records for Santa Cruz encompassed 2,708 storms. A rational method of storm sewer system design was used in conjunction with the least squares method of rainfall analysis to calculate the design discharge from the product of the runoff coefficient, the area serviced by the designed storm sewer, and the storm intensity over a specific duration and frequency. Rainfall intensity was derived as a function of storm duration and storm frequency. A computer program was developed to correlate data on storm frequencies of various durations and intensities with intensity-duration-frequency relationships for specific storm frequencies. The relationships were then used to estimate runoff in storm sewers by the rational formula. Calculated rainfall and runoff data were in close agreement with observed values. The information from the study was to be used in designing storm water sewers for the city of Bombay.

B085

EXPERIMENTAL STUDY OF DISCHARGE SIPHONS OF PUMPS IN THE PROJECT OF THE URBAN SEWER SYSTEM OF MONTREAL (Etude experimentale des siphons de decharge des pompes dans le cadre du projet d'assainissement de la communaute urbaine de Montreal),

Mitci, C.

Communaure urbaine de Montreal,
Service d'Assainissement des Eaux,
Montreal, Canada.

Tribune du CEBEDEAU, Vol. 31, No. 410, p 41-52, January, 1978. 13 fig, 5 tab, 6 ref.

Experiments were used to test two different discharge siphon designs for a pumping system planned to deliver municipal wastes and surface runoff from two interceptors in the Montreal sewer system to a sewage treatment plant. Parameters used to compare design performance included: charge loss, flow conditions in the siphon, and flow conditions in the sewer (water level, sediment transport, and pressure). Hydraulic characteristics and costs for operating pumping stations were also compared. Tests had disclosed that the presence of a stationary air pocket in the siphon of a variable speed pump necessitated the use of a vacuum pump not required under constant speed operation. For both constant and variable speed pumping, the siphon required a vent and a valve to prevent intake of air during priming; addition of a certain volume of air was necessary to unprime the siphon when pumping stopped.

B086

COMBINATION TANKER FOR SEWER JETTING AND GULLY EMPTYING,

Surveyor, Vol. 151, No. 4469, p 22, February, 1978.

Whale Tankers Ltd., Solihull, West Midlands, England, has manufactured a 2,600 gal tanker truck for municipal and industrial sewer jetting, washing, and gully emptying. The tank is divided into three compartments: the front for carrying clean water, the center for oily sludges, and the third for sludge and the gully arm. An air-cooled exhauster with a capacity of 60 cu ft/min is used to clear the tanks. A volume up to 75 gal/min is delivered by the high pressure piston pump at a pressure output of at least 700 bars. The tanker is used for sewer jetting and descaling in sewers up to 6 ft in diameter. The high pressure system is also capable of powering turbine rock-cutting heads for clearing blocked or collapsed sewers.

B087

TAKE THE PICK AND SHOVEL WORK OUT OF COMPUTATION,

Hablett, T. H.

Water and Wastes Engineering, Vol. 15, No. 4, p 52-54, April, 1978. 3 tab.

A computer program can adapt Manning's equation to calculate the diameter of gravity pipes when the pipe flow velocity and slope are known. Program 096, readily adaptable to programmable calculators, calculates the diameter and depth of the pipe as a function of water quantity discharged (Q(f)) and the velocity (V(f)) at a given friction. A chart relating diameter and depth to these calculated values is reproduced for a round corrugated-steel pipe having a Manning's coefficient for pipe interior roughness of 0.021. When Program 096 is used in conjunction with the chart, information on a specific gravity main is input in the following order: point number for beginning of gravity flow; gpm; difference between entry and discharge; horizontal length of pipe; slope; and Manning's coefficient. At this point, the nearest value correlating Q(f) to diameter and depth of flow is chosen from the chart and fed to the computer as follows: velocity; Q(f) from the chart; diameter; and water depth. The effectiveness of different pipe diameters can be compared by manual return to a specific stage within the program.

B088

NEW SEWER CLEANING SERVICE,

Water Services, Vol. 82, No. 985, p 184, March, 1978.

The Vactor 810 jet rodder for cleaning sewers is manufactured by a subsidiary of Vactor Industrial Pollution Ltd. of Winkleigh, Devon, England. The Vactor vacuum cleaning unit is mounted on a 16-ton two-axle truck and and employs a centrifugal pump which can handle both solids and liquids for filling its 6 cu m tank. The jet rodding system provides pressures up to 140 kg/sq cm for cleaning sewers from 100-1,000 mm in diameter at a rate of 150 m/hr. Liquids are drained from the full tank and solids remain so that the system can continue to operate. The number of trips required for the disposal of solids is reduced because the solids are allowed to accumulate during the cleaning process until the tank is full.

B089

BARGES CUT OUTFALL IN HALF,

Engineering News-Record, Vol. 200, No. 9, p 15, March, 1978.

A 38,000 ft outfall sewer in San Francisco Bay, California, was constructed with barge-mounted equipment at a substantial savings. The $15.8 million outfall, which is part of a $162 million project to upgrade sewage treatment in 7 Alameda County municipalities, cost less than half of the estimated expense of constructing an outfall to discharge wastes into 25 ft tidal waters. A channel was dredged instead of shoring a trench and all pipe was transported by barge from Santa Fe rather than by truck. Original plans called for transporting the pipes for the outfall on a hydraulically-operated apparatus that would walk to the site of the outfall. The pipe is constructed of 96-inch diameter reinforced concrete with 9-inch walls and is stabilized with a 4-ft cover within the trench. The outfall can accommodate a 75 mgd dry weather flow with a peak capacity of 185 mgd. Included in the entire project are a 20 mgd treatment plant, 6 pumping plants, 31 miles of interceptor sewers, and upgrading of 3 treatment plants.

B090

PLASTIC PIPE FOR DEEP SEWER,

Civil Engineering-ASCE, Vol. 48, No. 5, p 22, May, 1978.

Johns-Manville 14 inch polyvinyl chloride pipe was used for a gravity main sewer laid 42 feet beneath two Rocky Mountain foothills. Installing the gravity sewers over the hills would have required a pumping station. Constructing the gravity sewer through the hills required maintenance free and corrosion resistant pipe that could withstand heavy loads without deflection. The plastic pipe was laid in a 42-ft deep trench constructed with the proper bedding and width to control deflection. After the pipe was installed, it had a deflection of less than 4%. The sewerage project was designed by the engineering firm of Serafini and Meurer, Inc. of Denver, Colorado.

B091

REPAIRING DAMAGED SEWERS AND WATER MAINS,

Surveyor, Vol. 151, No. 4471, p 22, 24, February, 1978. 1 fig.

A terylene fiber-reinforced polyester resin lining for repairing damaged sewers and water mains has been developed by Edmund Nuttall Ltd. and Insituform Ltd. and distributed by Drainalay Ltd., a subsidiary of Power Rod Ltd., London, England. The lining procedure is accomplished via an access manhole and is suitable for pipes with diameters of 4-48 inches; pipes with diameters of 4-6 inches have been repaired with linings up to 100 m in length. Linings, in thicknesses ranging over 3-19 mm, are sheathed in polyurethane and vacuum-impregnated with Isophthalic resin for added structural strength and chemical resistance. The lining is fed into the opening of the pipe through a vertical steel inversion pipe with a perpendicular end. The lining is clamped to the end of the inversion pipe; water pumped through the inversion pipe builds up a pressure head, forcing the liner to turn inside out into the damaged pipe. A flexible hose is drawn through the pipe; the water pumping through the pipe is heated to 75 C; and the lining resin is cured. The resin curing requires about 2 hrs, after which the ends of the liner are trimmed and sealed onto the channel. The lined pipes can be used within 2-3 hrs; the flow characteristics of the liner reportedly compensate for the pipe's smaller diameter.

B092
SEWER PIPE SYSTEM PROTECTS SUBURB'S WATER SUPPLY,

Water and Sewage Works, Vol. 125, No. 5, p 59, May, 1978.

Johns-Manville polyvinyl chloride gravity sewer pipe, 'Transite' asbestos cement force mains, and polyvinyl chloride water pressure pipe were used in the sewerage project at Little Elm, Texas. The sewers transport municipal wastes to a sewage treatment plant utilizing contact stabilization and tertiary filtration. The Johns-Manville pipes were selected because of their corrosion resistance, ease of handling, and rapid installation. The clay soils of the 10 sq mile area necessitated the selection of non-metallic pipes with lightweight handling properties. The polyvinyl chloride gravity sewer pipes in 20 ft lengths were installed in about half the expected time because of less jointing and ease of handling. The asbestos cement force mains connecting the gravity sewers were installed at elevations of 12-27 ft and required less and lighter equipment during construction. The force mains were equipped with factory-belled couplings with rubber rings built into the pipe during manufacture; the rings were lubricated and joined with a bush-motion to connect pipe sections. The joint had an exfiltration rate of less than 250 gal/inch diameter/mi/day. Polyvinyl chloride water pressure pipes provided zero exfiltration when installed within 75 ft of a reservoir's high water elevation. The sewerage and treatment plant project alleviated pollution of the area's water supply via seepage from septic tanks in the area.

B093
POLYMER HELPS 'OVERFLOWS' GO DOWN THE DRAIN,

Hull, D. H.

Clinton Bogert Associates,
Fort Lee, New Jersey.

Water and Wastes Engineering, Vol. 15, No. 5, p 55-56, May, 1978. 1 fig.

Anionic polyacrylamide polymer injection into the sewage stream at the Tenafly, New Jersey, pumping station increased the plant's pumping capacity by 20% during overflow conditions. The 5.9 mgd maximum capacity of the pumping station had been exceeded by 1.2 mgd due to infiltration during periods of wet weather; by-passing of overflows was attributed to the empirical peak-to-average ratios employed in designing the pumping station. Infiltration/inflow analysis of the gravity sewer system identified inaccurate ratios of domestic and extraneous flows during peak conditions. The injection of an anionic polymer into the sewer system during overflow conditions included laminar flow conditions and increased flow velocity. Parallel operation of the pumping plant's centrifugal variable speed pump with a 4.8 mgd capacity and the gas-powered 75 hp pump increased the plant's capacity by 29% with the addition of 100 ppm of dry polymer powder, supplied by Hercules Powder Co. of Wilmington, Delaware. During overflow conditions, about $150-400 polymer/hr are required;

the polymer treatment is not yet amenable to automation. The Tenafly plant has employed polymer injection about once a year during severe storm conditions.

B094

COST-MINDED COMMUNITY CHOOSES SMALL DIAMETER GRAVITY SYSTEM,

Fey, R. T.

Water and Sewage Works, Vol. 125, No. 6, p 58-61, June, 1978.

Septic tank effluent from residences and businesses in Westboro, Wisconsin, is transported through small diameter gravity sewers to a tri-celled absorption field composed of sand and gravel. Existing septic tanks, the primary form of waste water treatment in Westboro, were replaced with circular or rectangular septic tanks; the ownership was transferred to the sewer district to insure regular pumping of sludges, scum, and other accumulations. Waste waters from these tanks are transported to two lift stations through polyvinyl chloride gravity sewers and force mains with diameters ranging over 1.5-3.0 inches. Effluent is then pumped to a 9,500 gal siphon chamber which periodically discharges waste water through one of three siphons leading to the absorption cells. The siphon chamber is designed to discharge about 8,400 gal four times each day through 12-inch diameter pipes to one of the absorption cells at an application rate of 1.25 gpd/sq ft. Effluent is uniformly distributed through perforated, manifold, and header pipes. The soil absorption field has a capacity of 30,000 gpd, sufficient for effluent from 120 homes. Seventy-nine homes, 5 businesses, and one school are currently connected to the system.

B095

AN ANALYSIS OF DESIGN LIFE STANDARDS FOR INTERCEPTOR SEWERS,

Binkley, C.

Urban Systems Research and Engineering, Incorporated,
Cambridge, Massachusetts.

Water Resources Research, Vol. 14, No. 2, p 365-368, April, 1978. 6 tab, 21 ref.

A capacity expansion model relating scale economies and inflation was developed to optimize the design life of interceptor sewers. The capacity expansion model is derived from a power function of costs, incorporating inflow capacity, a scale factor, and additional units of capacity. The cost of error resulting from incorrect scaling is described as the ratio of the incorrect design cost to the minimum design cost; error costs do not exceed 12%. Optimal design life and minimum costs without inflation are calculated by differentiating the cost equation. Cost equations for predicting economies of scale are developed from cross-sectional information on interceptor capacity and project costs or from simulation techniques incorporating the cost of materials, interceptor velocity, excavation costs, and other parameters. Cross-sectional information is usually considered to be more accurate. Inflationary costs of interceptor sewer construction are outlined for the period covering 1961-1974. The optimal design life, minimum cost, and costs of errors are then calculated with respect to relative inflation. The design standard for interceptors is calculated to be 20-30 years, considerably lower than the federal design standard of 50 yrs.

B096

HYDRAULIC DESIGN FOR COMBINED SEWER DIVERSION,

Pennino, B. J., and Perkins, R. A.

Worcester Polytechnic Institute,
Holden, Massachusetts,
Alden Research Laboratory.

Journal of the Hydraulics Division-ASCE, Vol. 104, No. HY5, p 595-606, May, 1978. 8 fig, 3 ref.

A 1:18 hydraulic scale model of a storm water retention basin, incorporated into an existing combined sewer system in Richmond, Virginia, maximized the design efficiency of conduits, distributors, and retention basin flows. The existing combined sewer system, which discharged an estimated 1,450,000 lb BOD/yr and 4,350,000 lb suspended solids/yr to the James River, maintained arch and box sewer tunnels which overflowed to the river during wet weather. Upgrading of the system to divert and store storm water overflows and to capture the initial pollutant load at the treatment plant included the construction of a 30,000 gal retention basin to store 60-70% of the overflow volume for treatment. The hydraulic scale model was designed to simulate flow characteristics and the impact of the level in the James River, the overflow weir head discharge, the retention basin level, and the performance of the arch and box diversion structures. The model studies concluded that streamlining outlets and crest gate sills and modifying the entrance roofs in the diversion structures would reduce water levels during maximum sewer flows and high river levels. The flow to the retention basin was maximized by streamlining and expanding connection and diversion conduits, and by flaring the diversion conduit outlet at the retention basin. Flow velocities at the arch sewer trash screen inlet were reduced by installation of columns extending over the entire flow depth. The model study minimized flow-through and diversion head losses in the system.

B097

CHICAGO PIONEERS IN CORRECTING WATER POLLUTION, CONTROLLING FLOODS,

Civil Engineering-ASCE, Vol. 48, No. 7, p 58-62, July, 1978. 5 fig, 1 tab.

A $2.8 billion Tunnel and Reservoir Plan under construction in Chicago, Illinois, will intercept combined sewer overflows and store the waste water for subsequent treatment when the storm subsides. The first phase of the project includes the excavation with a tunnel boring machine of 13-35 ft or 4.0-10.7 m diameter tunnels in the limestone strata 200 ft below the surface. The tunnel will receive an unreinforced surface coating to reduce rock breakage within the tunnel and to prevent exfiltration of sewage into aquifers which have a higher water table than the tunnels. Overflows will be retained in the tunnels and in a series of five reservoirs during storms and will be pumped to the treatment plants when dry weather flow resumes. As a cost-effective alternative to upgrading waste water treatment plants to tertiary treatment, instream aeration was chosen to maintain dissolved oxygen levels in receiving streams. Ten aeration units will supply an average of 165,300 lb 02/day to streams; instream aeration has the advantage of reducing non-point source pollutants that would not reach treatment plants. Districts lying outside Chicago's combined sewer system will be protected from flood damage by channel improvements and the construction of six reservoirs in the Upper Salt Creek Watershed.

B098

PROGRAM THE MANNING EQUATION,

Hart, E. C.

Camp Dresser and McKee Incorporated,
Boston, Massachusetts.

Water and Wastes Engineering, Vol. 15, No. 5, p 72, 74, 76, May, 1978. 2 tab.

The Texas Instruments SR-52 calculator can be programmed with the Mannings Equation for rapid calculation of pipeline discharge, area, wetted perimeter, and velocity. The SR-52 calculator, which costs less than $200, is programmed on the Algebraic Operating System, permitting direct entry of the program from left to right, with the addition of parentheses as written. The calculator has an established hierarchy in which functions, powers and roots, multiplication and division, and addition and subtraction are solved sequentially. Two programs are available for solving the Mannings Equation when the depth of flow in the pipe is in the range of 0.5-1.0 and 0-0.5. The SR-52 retains all input parameters, which may also be easily changed, and is attachable to the PC-100 for printout copies of solved programs.

B099

KNOW-HOW IMPORTANT IN REHABILITATING FLOODED SEWER LINES,

Malysko, R. W.

Department of Public Works,
Johnstown, Pennsylvania.

Public Works, Vol. 109, No. 5, p 62-64, May, 1978.

Water jetting, bucket machines, rodding, and scrapers were utilized by Robinson Pipe Cleaning Co., of Canonsburg, Pennsylvania, to remove debris from sewer lines in Johnstown, Pennsylvania, after the July 1977 flood. Water and debris were cleared from basements and elevator shafts by trash pumps and water jetting; water was discharged to open sewer lines or transported by 3,000 gal tank trucks to the Conemaugh River. Main sewer lines leading to the 25 mgd sewage treatment plant were initially cleared to restore the flow in 145 miles of municipal sewers. The concrete or terra cotta pipes, with diameters ranging over 8-60 inches, were cleaned with bucket machines and high-velocity water jetting, in sections averaging the distance between 2-3 manholes. More than 80 miles of brick, stone or concrete storm sewers with diameters ranging from 18-96 inches were cleared by rodding scrapers attached to bucket winches. Deremoved from the lines such as tree limbs, mud, rock, road base materials, telephone poles, railroad ties, and auto parts, were deposited in dump trucks by clamshell equipment or tractor shovels for subsequent disposal.

B100

SURFACE WATER AND FOWL SEWER SCHEMES,

Water Services, Vol. 82, No. 987, p 313-314, May, 1978.

England's Thames Water Authority has contracted P. Trant Ltd. to construct surface water sewers in Old Poole town and waste water sewers in the Newbury. Both sewerage systems will pass under railway lines through small tunnels that will be driven without disrupting rail service. The Old Poole storm sewer project will include manholes and 1.4 km of sewer lines with diameters ranging 225-975 mm. The project also includes the construction of two pumping stations, equipped with twin screw Archimedean pumps with maximum capacities of 330 gal/sec. The line beneath the railroad bed will be passed through a bore thrust, 900 mm in diameter. The Newbury project will include 2.25 km of 300-600 mm diameter sewers laid up to 6 m deep due to ground conditions, and 1 km of 350 mm polyvinyl chloride pipe pumping main. The tunnel beneath the rail tracks will be 1000 mm in diameter; a pumping station near the tracks will be constructed at a depth of 8 m. Steel sheet-piled cofferdams will be required to shore up the side of the excavation during construction because of the trains' vibrations.

B101

DESIGN PROLONGS SERVICE LIFE OF CORRUGATED STEEL PIPES,

Water and Sewage Works, Vol. 125, No. 4, p 60-61, April, 1978.

Coatings and linings increase the performance and durability of corrugated steel pipes. The steel pipes are manufactured with a 2 oz/sq ft zinc coating and often an 0.05 inch hot-dip compound asphalt internal and external coating which can extend the pipes' durability by 25 yrs. Asphalt pavement poured in the critical flow or invert section areas can further increase pipe durability. Coating the pipe interior with centrifugally spun asphalt during pipe rotation improves the hydraulic performance. Polymer coatings applied to steel coil stock in thicknesses of 0.010 inches to 10 mils provide resistance to corrosive acids, alkalis, brackish water, and industrial solvents. Asbestos-bonded fibers applied to molten zinc during galvanizing, followed by asphalt-based saturant coating, also protect pipe materials against corrosives. Coatings of anodic iron-zinc and aluminum-zinc alloys and cement mortar protect underlying metal. Installation recommendations include: gradients steep enough to prevent solids accumulations, sand and gravel as backfill to reduce external corrosion, and proper coupling materials for bituminous-coated corrugated pipes.

B102

EVALUATION OF FLUIDIC COMBINED SEWER REGULATORS UNDER MUNICIPAL SERVICE CONDITIONS,

Freeman, P. A.

Peter A. Freeman Associates, Incorporated,
Berlin, Maryland.

1977. 104 p, 34 fig, 4 ref, 3 append. Technical Report EPA-600/2-77-071.

The performance of two fluidic regulators, installed under a grant by the USEPA Demonstration Program in a section of combined sewers in Philadelphia, Pennsylvania, is compared to the performance of static regulators. The fluidic regulators are evaluated as a means of overcoming the hydraulic problems of static regulators that are controlled by only the flows in combined sewers. Dynamic regulators can respond to both combined and interceptor sewer flows, but are more expensive and less reliable than fluidic regulators. The fluidic unit is controlled by tube sensors located in combined and/or interceptor sewers. The design and construction details of the project are described; a detailed comparison is made of the hydraulic performance, maintenance, and costs associated with static and fluidic regulators. One regulator has been operating adequately for 36 mos under combined flows of 2 cu ft/sec; the second fluidic regulator has accommodated flows of 25 cu ft/sec for 30 mos with few problems. Specific design modifications to the fluidic regulators, including corrosion-resistant construction materials, rerouting of connecting air lines, and inlet nozzle expansion, were formulated to improve the operation of the fluidic regulators. Routine surveillance practices and maintenance operations were simpler and faster than with static regulators.

B103
SEWER RESTORED BY THERMOSET RESIN CURED IN PLACE,

Jacobson, A. R.

Illinois State University,
Normal,
College of Applied Science and Technology.

Public Works, Vol. 109, No. 7, p 94, July, 1978.

A brick sewer in Kidderminster, England, was repaired by the Insituform process which utilizes a resin-saturated polyester tubing liner. A polyester needle felt tube of the same dimensions as the sewer was saturated with a thermosetting resin and inserted into the sewer line. The tube was filled with cold water to maintain pliability and to push it through the pipe; the water in the tube was then heated to cure and set the resin-saturated liner. The Kidderminster pipe, located beneath a factory, was 1,800 ft long and had a 30-inch diameter. Underground Surveys Corporation of Fresno, California, are North American suppliers of the Insituform process.

B104
THE PORTOBELLO OUTFALL AT BRIGHTON,

Water Services, Vol. 82, No. 988, p 356-357, June, 1978. 2 fig.

A 2.13 m internal diameter, 1,830 m long tunnel discharges waste water from the Portobello, England, treatment plant and pumping station into the ocean at a depth between 14.4-20.2 m. A 44 m vertical shaft leading to the tunnel was supported in the area's water-bearing chalk by peripheral ring grouting. The diffuser system, located along the last 347 m of the tunnel, consists of 9 vertical shafts connecting the four-port diffuser heads to the tunnel to provide 36 outlets. Grouting and cast iron rings were required during excavation below 1080 m because of chalk deterioration. The chalk face was excavated by hand with air tools and a Markham shield. Pumps were required to remove water during excavation of the diffuser shafts. The completed outfall tunnel has a capacity of 1,495 gal/sec.

B105
MONTREAL SEWER CONTRACTOR IS FORCED TO USE HIGH AIR PRESSURE IN TREACHEROUS CLAY,

Brown, J.

Engineering and Contract Record, Vol. 91, No. 6, p 40-41, June, 1978.

Compressed air at pressures up to 124 kiloPascals was used where unstable ground conditions existed in the tunneling areas of Montreal Urban Community's sewerage project. The compressed air stabilization was required after a cave-in trapped the tunneling machine in one of the sewerage construction sections and also because of unstable clay and silt in three other sections 42, 43, and 78 m in length. Manual excavation within the compressed air lock areas was completed prior to tunneling with the mole. Air was supplied through 152 mm diameter lines at a rate of 276 cu m/min and pressures of 96-124 kiloPascals. Deep wells with 22 kilowatt submersible pumps were required in one section to reduce water inflow from 5,455 to 2,273 liters/min. Heading and bench methods of excavation were employed in areas which had been drilled and blasted; 1.2 m-long, 19 mm-diameter rock bolts prevented rock spalling. Strict schedules were required for employees working under the compressed air; at 96 kiloPascals, continuous working time was limited to 3.75 hrs. A medical lock similar to a decompression chamber was required for treating employees with the bends; medical personnel were maintained on-site. The use of compressed air also limited the equipment to air or electric power and influenced the selection of explosives. The 8,473 m sewer tunnel will be lined with concrete when completed.

B106

SWANSEA'S SEA OUTFALL IS TAILOR-MADE,

Surveyor, Vol. 151, No. 4486, p 7-9, June, 1978.

The design and construction of the major outfalls along the South Wales coast, discharging municipal sewage and industrial wastes into the Bristol Channel and Severn Estuary, are described. A 1,100 m-long storm water outfall into Swansea Bay was part of the sewerage project in the Sandfields and Swansea area. The 1,675 mm external diameter pipe has walls 12.7 mm thick, a flow rate of more than 1,651 liters/sec, and is constructed of spirally-welded steel sections; the sections were joined in strings seven units long and towed into position. The Swansea sewerage project also included construction of 725 m of sewers, 215 m of precast concrete pipelines and manholes, 360 m of spun iron rising main, a pumping plant, and associated sewers and pipelines. Outfalls still in the planning stages include sludge and sewage disposal lines; the nine sewage and industrial outfalls located along the cost of South Wales range in length over 1,100-3,500 m.

B107

HYDRAULIC SHEET PILE DRIVER HAMMERS DOWN SEWER TRENCH COSTS,

Hancock, N.

Engineering and Contract Record, Vol. 91, No. 6, p 74-75, June, 1978.

The Hydraulic Trench Master, manufactured in West Germany, drives sheet piles for sewer construction in unstable ground conditions or in narrow trenches from 2-18 ft wide. The hydraulic unit, which can simultaneously drive piles on both sides of the trench to be excavated, reduces shoring costs by 50% and eliminates the need for dewatering of narrow trenches in saturated soils. The 700 mm wide, 3.5 m long interlocking sheet sections can be driven to depths up to 40 ft by the continuous pressure, medium weight impact of the hydraulic hammer unit; the driving technique allows reuse of sheet piles which are removed by an air-operated extractor mounted on a crane. The hydraulic unit is equipped with a 125 hp diesel motor and usable within one foot of a trench wall.

B108

WATER POLLUTION CONTROL WITH INTERCEPTORS,

Blenderman, L.

Domestic Engineering, Vol. 232, No. 1, p 38-40, 80, July, 1978. 6 fig, 1 tab.

The county of Monroe, New York, adopted a sewage use law to control the size, installation, and servicing of grease, oil, and solids interceptor sewers. Failure to empty sewers or improper cleaning practices by interceptor sewer owners, such as restaurants, gas stations, and food processing plants, led to the adoption of inspection and fining regulations. The county inspects the number of hook-ups, the flow volume, and the type and size of the interceptor to be installed before a building permit is issued. The contractor or plumber must comply with regulations for flow restriction units and baffles and interceptor location; he must also instruct the owner in the use and maintenance of the interceptor. When an interceptor becomes plugged due to an owner's failure to empty it, the county cleans the sewer and a violation citation is issued. The occurrence of a second plugging subjects the owner to a warning, followed by a fine and a cleaning charge for the third plugging incident. Cleveland, Ohio, has similar sewage use laws.

B109

SMALL CONTRACTORS TAKE ON TOUGH PIPE PLACEMENT,

Engineering News-Record, Vol. 201, No. 4, p 28, July, 1978.

A 15 ft steel elbow was used to connect an 84-inch diameter interceptor sewer to a new 72-inch diameter line that directs sewage to grit and screening operations in Newark, New Jersey. The 72-inch pipe consists of prefabricated concrete sections that were embedded in concrete to line an abandoned interceptor. The 2.5-ton elbow, which connects the refurbished line with Newark's city and airport interceptors, was bolted and braced in place within 6 hrs. Work was hastened when sewage behind the blocked-off construction site threatened to overflow into city streets. The elbow had one round flanged end and one square end connecting to a concrete sluice; the pieces were bolted in place, thrust braced, and connected to the lines with vertical supports. The new line is part of a waste water treatment project currently under construction for Newark. Vacar Construction Corp., of Williston Park, New York, was the subcontractor for the elbow installation.

B110
ANSWERING MECCA'S SEWERAGE PRAYERS,

World Water, Vol. 1, No. 1, p 42-43, 45, May, 1978.

Sewage treatment facilities and sewer systems in Mecca, Saudi Arabia, must accommodate flows during pilgrimage periods that are double the normal flows. The English engineering consulting firm of J. D. and D. M. Watson has designed and supervised the construction of 65 km of trunk sewers, up to 1.02 m in diameter, and 200 km of smaller sewers. To prevent corrosion of sewer pipes by thiobacillus concretivorus, the sewers have been installed with adequate gradients to prevent siltation and septicity; the trunk pipes are constructed of clayware and the minor sewers are asbestos cement lined with epoxy to resist sulfide corrosion. Periodic floods are controlled by a network of trapezoidal concrete-lined sand channels surrounding the city to divert surface runoff from flowing into the dry river beds that comprise the city's main streets. One network of channels is 2 m deep, 2 m wide at the base, and 10 m wide at the top; the other network has channels with depths of 2.5 m and a bottom-to-top width range of 1.5-6.5 m. The only operational sewage treatment plant employs primary treatment, filter beds, humus tanks, primary digestion tanks, and sludge drying beds. Treated effluent may eventually irrigate green belts around the city; effluent is currently discharged into the dry river beds. The Watson engineering firm also supplied the designs for upgrading Mecca's 9th century vintage aqueduct water supply system.

B111
LASER MADE FOR PIPE-LAYING,

Surveyor, Vol. 151, No. 4484, p 26, May, 1978.

The 1055 Dialgrade laser, developed by Spectra-Physics Ltd. of St. Albans, Hertsfordshire, England, is equipped with two axis level compensation for rapid, automatic levelling in pipe emplacement. During set-up, the laser is rough-levelled; after the initial set up, the laser automatically levels ±5 degrees within one minute. The laser moves right or left over a ±4 degree range and over ±3 degrees in a perpendicular direction. Push button level controls are located on the back of the unit which has a viewing telescope for following the beam. The laser automatically levels in a 6-inch diameter pipe with a grade of 9% when the unit's rubber bumpers are removed; the laser is centrally aligned with the rubber bumpers in 8-inch diameter pipes. One invert mounting plate is required when the unit is operated in pipes with diameters of 10-15 inches; in larger pipes or flat-bottomed manholes, a trivet mounting is used. The laser is equipped with a signal light and a warning system to inform the operator of adjustment requirements.

B112

COMBINED SEWER CLEANER,

Water and Waste Treatment, Vol. 21, No. 7, p 27, July, 1978.

General Descaling Co. has designed a sewer cleaning vehicle for simultaneous high-pressure water jetting and suction removal of manhole deposits. The unit, designed for single crew operation, contains a 700 gal sludge tank and a 1000 gal water tank, both constructed of 0.25 inch mild steel and internally coated for corrosion resistance. The two tanks are mounted on a two-axle 16 ton chassis. A valve between the two tanks may be opened to allow a larger sludge or water capacity. The triple-ram positive displacement pumps for water jetting are available with capacities of 22 gal/min at 1,500 lbs/sq inch or 45 gal/min at 1,250 lbs/sq inch. The water jet is supplied through 300 ft of braided-rubber hose; controls and monitoring equipment are mounted on a panel adjacent to the hose reel. A rotary vane air exhauster with an output of 26,500 cu ft/hr and 4-inch diameter hoses comprise the suction equipment. The vehicle and its operations are powered by a Perkins turbo-charged diesel engine with a five-speed gearbox.

B113

SOME THOUGHTS ON PIPELINES PAST, PRESENT AND FUTURE,

Andrews, E. N.

Public Health Engineer, Vol. 6, No. 3, p 151-157, 1978. 3 fig, 1 tab, 6 ref.

The properties and applications of iron, steel, plastic, concrete, clay, and pitch fiber pipes are reviewed for use in sewerage, water supply, gas and oil transport, drainage, and industrial structures. High-speed spun concrete pipes provide a high crushing strength, high density, corrosion resistance, smooth concentric bores with abrasion resistance, and accurately-formed jointing surfaces. Fiberglass is often used in place of steel for reinforcing concrete pipes. Gas lines are typically constructed of cast or ductile iron, polyethylene, or steel; water supply pipes can be constructed of a variety of materials such as iron, concrete, asbestos, polyvinyl chloride, polyethylene, and reinforced plastics. Rigid pipes, such as asbestos cement, gray cast iron, clay, and concrete, support the entire trench and the superimposed material or traffic load; flexible pipes transfer the vertical load of the soil to a horizontal plane which is supported by the trench walls. Pipeline manufacturing faults, design errors, environmental conditions, and installation and operational problems contribute to pipeline failure; soil surveys, groundwater sampling, water monitoring, and stress testing are recommended to prevent pipe failures.

B114
THE LAYING OF UNDERWATER POLYETHYLENE PIPELINES USING THE ATMOSPHERIC COUNTER-PRESSURE METHOD (Das Verlegen von Seeleitungen aus Polyathylenrohren im Luftgegendruckverfahren),

Ursprung, H. G.

Gas- und Wasserfach, Wasser-Abwasser, Vol. 119, No. 5, p 262-266, May, 1978. 5 fig.

An atmospheric counterpressure method was developed for emplacement of tubular polyethylene pipes in deep water or in unstable ground without subjecting the pipe to bending stresses or tension. Conditions affecting polyethylene pipelines in deep water or in unstable ground cannot be adequately controlled by calculating the unit stress of the material. Consideration of all internal and external pressures on the pipe material at the moment of sinking is recommended to prevent unnecessary stress. The counterpressure technique of sinking the pipe was developed mathematically and graphically from the parameters: horizontal and vertical water resistance, work of pipe weight, buoyancy, energies of the air and flooded water columns, the length of the flooded water column, the allowable impact, and the sinking velocity. Input of these factors into an atmospheric counterpressure model permits control of the flooded pipe's movement during sinking operations.

B115
DISPATCHER SIGNALIZATION OF OPERATIONAL DISTURBANCES IN SEWER SYSTEM PUMP STATIONS (AID FOR DESIGNERS) (Dispetcherskaya signalieatsiya o naru shenii normal'nogo rezhima raboty kanalizatsionnykh nasosnykh stantsii) (v pomoshch' proektirovshchiku),

Ivashkov, A. S.

Vodosnabzhenie i Sanitarnaia Tekhnika, No. 3, p 34-35, 1978. 2 fig.

A relay-type signalization network using telephone cable has been developed for transmitting data on operational disturbances in sewer system pumping stations. The distance over which the signal can be transmitted ranges from 5 to 15 km, depending on the diameter of telephone wire employed (0.5-1.2 mm). The system can notify operators of a variety of conditions, encompassing flooding of the pumping station, power losses, and other pumping plant defects.

PATENTS

C001
TREATMENT OF SEWAGE

Smith, K. C., and Garrett, M. E.

BOC Limited,
London, England. (assignee)

United States Patent 4,039,437. Issued August 2, 1977. Official Gazette of the United States Patent Office, Vol. 961, No. 1, p 253, August, 1977.

A sewage treatment process which reduces the biochemical oxygen demand of sewage while it is entrained in a sewer has been patented. Pressurized oxygenated gas is injected into the sewer to provide aerobic conditions suitable for the growth of microorganisms. A longitudinal biological contactor which is attached to the upper surface of the sewer pipe is designed to provide a suitable matrix for microorganism growth without obstructing sewage flow. The matrix, which contains a bed of solid material to increase surface area available for microorganism growth, extends longitudinally for a significant distance through the sewer but does not extend below the central axis. Sewage flows through the matrix via a series of longitudinal passages created by separated pieces of sheet material.

C002
SYSTEM FOR POLLUTION SUPPRESSION,

Armstrong, E. T.

TII Corporation,
Lindenhurst, New York. (assignee)

United States Patent 4,045,347. Issued August 30, 1977. Official Gazette of the United States Patent Office, Vol. 961, No. 5, p 2227, August, 1977.

A disinfectant mixing system for use with influent in waste water treatment has been patented. The system uses a contact tank which includes: an influent inlet port which feeds a manifold, a pipe bundle with flat-plate orifice; high momentum exchange mixing members; and influent and effluent wells. A disinfecting fluid is injected into each pipe of the bundle at the point of highest momentum exchange. Effluent from the pipe bundle is delivered to a contact tank via a hyperbolic transformed diffuser. After the effluent is contacted with the disinfectant, it flows to an effluent trough.

C003
WASTE TREATMENT SYSTEM,

Bowen, J. H.

BDH, Incorporated,
Rome, Georgia. (assignee)

United States Patent 4,042,509. Issued August 16, 1977. Official Gazette of the United States Patent Office, Vol. 961, No. 3, p 1278-1279, August, 1977.

A waste water treatment system which employs ozone for oxidation of effluent has been patented. The system includes: a conduit to supply effluent, a self-cleaning filter assembly to remove solids from the effluent, and an ozone and oxidation assembly for treating effluent. Filtered effluent which has been subjected to oxidation and ozonation passes through an ultrasonic sound-generating assembly to break down particles in the effluent. The effluent then passes through a casing in which ozone is generated with an electric arc. A germicidal chamber and a chlorinator are provided for disinfection of the effluent.

C004
SEWAGE SYSTEM,

United States Patent 4,049,013. Issued September 20, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 3, p 1063-1064, September, 1977. 1 fig.

An improved design for a sewage pumping station has been patented. The station is circular and has a drywall which is surrounded by an annular series of wells. Sewage can be distributed sequentially among portions of the series of wells without the need for an additional power source. Sewage can also be delivered selectively to the pumping system in a predetermined sequence.

C005
CHEMICAL WASTE WATER TREATMENT METHOD,

Horvath, P. J.

Rocky Carvalho,
Salem, Oregon. (assignee)

United States Patent 4,049,545. Issued September 20, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 3, p 1235-1236, September, 1977. 1 fig.

A chemical method of treating waste water which has a pH below 9.0, contains nitrifying bacteria, and has in excess of 200 mg total solids per liter has been patented. The process is suggested for use with municipal, industrial, commercial, and agricultural waste waters which contain organic wastes. The pH of the waste water is first raised to 9-11 to kill any nitrifying bacteria. This is accomplished with the addition of an alkaline coagulant such as portland cement, lime, or sodium silicate. An acidifying agent such as copper sulfate, sulfuric acid, hydrochloric acid, aluminum salts, or ferric iron salts is then added to lower the pH by one unit and cause the precipitation of suspended solids. After the aggregated suspended solids are removed from the mixture, the pH is lowered again to 6-8.5 to further precipitate any suspended solids. Once these solids are removed, an oxidizing and disinfecting agent is added to render the remaining solids filterable. After the mixture is filtered, a second oxidizing and disinfecting agent is added to lower the BOD level to less than 20 mg/liter.

C006

WATER TREATMENT SYSTEM,

Borchardt, J. A.

Environmental Filtration Products, Incorporated,
Orlando, Florida. (assignee)

United States Patent 4,051,032. Issued September 27, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 4, p 1723, September, 1977. 1 fig.

A patent has been issued for a waste water treatment system composed of a closed tank with an effluent inlet and outlet at opposite ends of the tank to provide a horizontal flow of waste water through the system. A number of septa are provided to divide the tank serially into subchambers along the effluent flow path. The septa are filled with a particulate media so that effluent first passes through a coarse particulate medium and then through a fine particulate medium. The coarse medium can be horizontally backwashed, and the chamber containing the fine medium can be expanded and vertically backwashed.

C007

ANAEROBIC PROCESSING OF BIOCHEMICAL WASTE - FORMING LOW MOLECULAR WT. MATERIAL AND VOLATILE ACIDS, THEN DIGESTING RESIDUE FORMING METHANE,

French Patent FR 2324-581. Issued May 20, 1977. Derwent French Patents Abstracts, Vol. Y, No. 25, p D6, August, 1977.

An anaerobic treatment process which breaks down high molecular weight organic compounds into low molecular weight compounds, and low molecular weight organic compounds into volatile organic acids, has been patented. Biochemical wastes are initially processed in the presence of acid. After treatment and separation, methane and carbon dioxide are produced in a digester from the non-decomposed sludge fraction. The remainder is recycled through the initial treatment stage. Processing, separation, and digestion are then repeated.

C008

SUSPENSIONS SLUDGE GRAVITY SEPARATOR-WITH STABILITY INCREASED BY VERTICAL MOVEMENT MECHANISM OF FILTER ELEMENTS,

Soviet Patent SU-391-837. Issued November 14, 1973. Derwent Soviet Inventions Illustrated, Vol. Y, No. 3, p D1, August, 1977.

A cylindrical-control device for the gravity separation of suspensions, including sludge, has been patented. The gravity separator, with pipes and filter elements on top of its casing, is vertically moveable by means of a pair of screw elements. The casing is filled with a mixture of coagulant, flocculator, and waste water and is equipped with a filtration pipe, a turbidity gauge, and a sludge level control device. The sludge level is maintained so that the optimum high suspension zone is in the region of the filter elements. The turbidity gauge activates the reversing drive of the vertical movement mechanism via a signal amplifier.

C009

ORGANIC WASTE TREATING AND CONVERSION SYSTEM,

United States Patent 4,050,907. Issued September 27, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 4, p 1686, September, 1977. 1 fig.

A system for the treatment and conversion of organic wastes has been patented. The system includes a waste treatment tank equipped with a heating fluid conduit circuit. The portion of the heating conduit which passes through the waste treatment tank can be vibrated; and a pump is provided to circulate the fluid within the circuit. The fluid is heated by a furnace outside of the tank and supplemental heating in the external portion of the conduit circuit. Gas generated in the waste treatment tank is used for combustion in the furnace. The tank itself is a vertical well which has a depth substantially greater than its width. The heating fluid conduit circuit is a wire loop which passes through the well. Radiation diffusers are located at the top of the well and means for recovery of waste-generated gases are provided.

C010

SEWAGE PURIFICATION PROCESS,

German Patent DS-1642-509. Issued August 11, 1977. Derwent German Patents Abstracts, Vol. Y, No. 33, p 47, September, 1977.

A waste water purification process to reduce the COD of sludge by wet oxidation has been patented. Partial wet oxidation with excess gaseous oxygen reduces the COD by 10-45%. The solids are separated from the mixed liquor, which contains ammonia nitrogen, and cooled to 75-108 C. A portion of the effluent is then returned to the sludge tank to create temperature conditions of 30-60 C and an ammonia nitrogen content of less than 1.0 g/liter. The treatment equipment should be arranged so that the sludge tank is connected to a settling tank and to a heat exchanger-wet combustion reactor unit. Provisions should be made to maintain anaerobic conditions in the sludge tank in spite of the influent waste water characteristics.

C011

ACTIVATED SLUDGE TREATMENT OF PHOSPHATE- CONTG. AQ. EFFLUENT - WITH PRIM. ANAEROBIC STAGE AND SEC. AEROBIC STAGE TO PREVENT FORMATION OF THREAD-LIKE MICROORGANISMS,

Belgian Patent BE-853-318. Issued August 1, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 32, p 97, September, 1977.

A process for inhibiting the growth of filamentous microorganisms during the activated sludge process has been patented. The circulating activated sludge is mixed with a BOD-containing aqueous effluent. Anaerobic conditions with less than 0.7 ppm dissolved oxygen and virtually no nitrogen oxides are maintained to promote absorption of BOD by non-filamentous microorganisms. The mixed liquor is then aerated in an oxygenation zone with a dissolved oxygen concentration of greater than 1 ppm to remove the BOD. A settling zone is employed to separate the purified supernatant from the oxygenated mixed liquor. Part of the settled sludge is returned to the mixing zone for further treatment. The treatment process is reported to result in improved sludge settling characteristics and the elimination of bound phosphates in the effluent water.

C012
PHOSPHATE REMOVAL FROM BOD-CONTAINING WASTEWATER,

Matsch, L. C., and Drnevich, R. F.

Union Carbide Corporation,
New York, New York. (assignee)

United States Patent 4,042,493. Issued August 16, 1977. Official Gazette of the United States Patent Office, Vol. 961, No. 3, p 1273, August, 1977.

A method of phosphate removal from waste water during the activated sludge process has been patented. The phosphate-containing waste water is mixed with activated sludge and oxygen-containing gas in an aeration zone. While the fluid is circulated, microorganisms take up the phosphate and reduce the BOD content of the waste water. The phosphate-rich sludge is separated from the mixed liquor and passes through a phosphate stripping zone. Anaerobic conditions are maintained for part of the sludge, resulting in a phosphate-rich liquid and a phosphate-poor sludge fraction. The phosphate-rich liquid is removed and a portion of the sludge is recycled to the aeration zone. Phosphate stripping is enhanced by retaining sludge in the stripping zone for 2-10 hrs, introducing a stripping medium which has a low suspended solids and phosphate concentration, and maintaining a flow rate through the stripping zone of 0.7-2.0 times the rate of removal of phosphate-enriched liquid.

C013
METHOD OF TREATING SEWAGE SLUDGE,

Hara, S., and Kato, T.

NKG Insulators, Limited,
Nagoya, Japan. (assignee)

United States Patent 4,050,390. Issued September 27, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 4, p 1511, September, 1977. 1 fig.

A method of sewage sludge dewatering in a multiple hearth furnace has been patented. The sludge is dried in the upper part of the multiple hearth furnace and reduced to ashes by pyrolysis in the lower portion of the furnace. Exhaust gases produced during both operations are collected independently. The exhaust gas produced during the drying stage is dehumidified and then mixed with gas resulting from pyrolysis. Preheated gas is added to this mixture and the total mixture is burned in an after-burner. The combustion gas is discharged into the atmosphere and the heat generated in the after-burner is used to produce the preheated gas.

C014

APPARATUS FOR THE AEROBIC TREATMENT OF LIQUID WASTE,

Boschen, W. O., Annichiarico, A. V., and Johnson, A. L.

Ralph B. Carter Company,
Hackensack, New Jersey. (assignee)

United States Patent 4,051,035. Issued September 27, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 4, p 1724, September, 1977. 1 fig.

A system for the aerobic treatment of liquid wastes has been patented. The system includes a liquid basin which is equipped with an array of continuous gas distribution lines with orifices for the release of a gas such as air. A mixing-aerator device can be placed above any of the orifices to enhance mixing and aeration of the liquid waste and gas. The system is improved by the addition of a number of brackets to correspond and connect to the array of gas distribution lines. The mixer-aerator can be selectively attached to the brackets. At least two rigid legs extend between the mixer-aerator and the bracket and are equipped with a foot at the end of each leg. The foot is manually fastened to a receptor when the mixer-aerator is in place upon the selected bracket, and can be disengaged without dislodging the gas distribution line.

C015

ACTIVATED SEWAGE PLANT AND PROCESS,

Heaney, D. F.

Dravo Corporation,
Pittsburgh, Pennsylvania. (assignee)

United States Patent 4,051,039. Issued September 27, 1977. Official Gazette of the United States Patent Office, Vol. 962, No. 4, p 1725, September, 1977. 1 fig.

A filter design for use with settled activated sludge process effluent prior to chlorination has been patented. The filter has a perforated false bottom on which a filter bed of not less than 6 ft is supported. A headspace at the top of the filter is provided for influent, unfiltered water. Gravel-like, rounded quartz particles ranging in size from 1-3 mm comprise the filter media. The particles should be reasonably well sorted, having an average size difference not greater than 1 mm. A valved discharge outlet is located below the false bottom for removal of filtered water. When the filter is being backwashed, the value outlet is closed and air is forced into the space below the false bottom. The filter is equipped with an overflow weir for receipt of backwash water.

C016

FEEDSTUFF FROM SLUDGE WASTE,

German Patent DS 1937-580. Issued September 22, 1977. Derwent German Patents Abstracts, Vol. Y, No. 39, p 2, November, 1977.

A process for preparing feedstuff from sewage sludge derived from mechanical, biological, or mechanical-biological breakdown processes has been patented. The sludge is preferably mixed with fresh or partially matured compost in a ratio of 10:1 to 1:2 based on dry weight. The mixture, which should have a moisture content of at least 25%, is then heated continuously or in batches at a temperature of 105- 160 C, preferably in the range 110-130 C, for up to 5 min. The mixture should be heated for a time period sufficient to insure sterility of the product.

C017

PLASTIC LINED CONCRETE CHANNEL FOR WASTE WATER PURIFICN. PLANT - ASSEMBLED FROM PREFABRICATED MODULAR ELEMENTS WITH SEALED PLASTIC JOINTS,

Belgian Patent BE 852-803. Issued September 23, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 39, p 2, November, 1977.

A plastic lined channel has been patented for use in oxidation during waste water treatment. The elongated channel is constructed of a series of tubular parallelpiped elements, each of which is equipped with inlet and outlet openings of the same size and lined with a sheet of thermoplastic material which extends through the openings to form flaps. During assembly of two elements for continuous flow, the outlet of one element and the inlet of the other element are superimposed and the corresponding flaps and lining of thermoplastic material are seam-welded together. A manhole aperture can be placed at the top of an element which has two open ends for straight-through flow. In this instance, the thermoplastic sheeting is secured during casting of the concrete by protruding studs on one side of the sheeting. The prefabricated modular elements are designed to allow rapid construction of channel oxidation zones of any size and shape in waste water treatment plants.

C018

BIOLOGICAL PURIFICATION OF INDUSTRIAL AND DOMESTIC WASTE WATER - BY PERIODIC FLOODING OF FILTRATION BEDS TO A SPECIFIED DEPTH,

Soviet Patent SU 529-128. Issued December 14, 1976. Derwent Soviet Inventions Illustrated, Vol. Y, No. 37, p 5, October, 1977.

A waste water treatment process which involves periodic flooding of filtration beds for municipal and industrial wastes has been patented. During the flooding period waste water is applied to a depth of 0.5-1.0 m relative to the depth of the filter bed, to increase treatment efficiency and equalize winter and summer performance. In later stages waste water is applied at a rate of

0.2-0.3 m until the initial depth of 0.5-1.0 m is reached on a daily loading basis of 300-500 cu m/hectare. The periodic nature of the flooding preserves aerobic conditions, inhibits the growth of microorganisms and other aquatic life, and insures the presence of algae in the water. Oxidation and self-purification in the bed is continuous through summer and winter.

C019

WASTE WATER FILTRATION PROCESS - WHICH DOES NOT BLOCK THE FILTER, EFFECTED BY SEQUENTIAL ADDN OF ALUMINATE, SILICATE AND AMMONIUM/POLYVALENT CATION SOURCE,

French Patent FR 2334-632. Issued August 12, 1977. Derwent French Patents Abstracts, Vol. Y, No. 39, p 5, November, 1977.

In a recently patented waste water filtration process, 0.004-0.04 moles/liter of an alkali aluminate are added to the waste water, followed by 0.006-0.2 moles/liter of an alkali silicate, 0.001-0.2 moles of a soluble ammonium source and/or a source of soluble Ca, Mg, Fe, Al, Ba, Co, Cd, Sr, and/or Cu. The waste water should have a pH of more then 5.5 before any chemicals are added. The treatment process, which uses readily available chemicals, does not block the filter and produces a highly dewatered complex of recovered solids for safe storage, handling, and benefical use. The filtrate which is produced is free from particulate matter, many dissolved substances, and microorganisms.

C020

PHOSPHATE STRIPPING OF SEWAGE,

Australian Patent 485,436. Issued August 11, 1977. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 47, No. 29, p 2674, August, 1977.

A phosphate stripping process has been patented by the Union Carbide Corporation for use in conjunction with activated sludge treatment. Mixed liquor which includes phosphate-containing influent sewage and activated sludge passes through an aeration zone, where the BOD is reduced and microorganisms take up phosphate. The phosphate-enriched sludge is separated from the substantially phosphate-free supernatant and passed to a phosphate stripping zone, where anaerobic conditions are maintained to cause the release of the phosphate to the liquid phase of the settled sludge. The sludge containing the phosphate-enriched liquid is contacted with a lower phosphate content medium to remove the phosphate from the anaerobic sludge liquid phase. A portion of the sludge is returned to the phosphate stripping zone.

sists of nitrogen, hydrogen or alkyl, and two alkyl radicals having from one to six carbon radicals or alkenyl radicals which have from two to six carbon atoms, yielding a total of three to seven carbon atoms in the molecule. The amine should also have an inverse critical solution temperature in a two phase system with water. The temperature of the mixture is adjusted to below the critical solution temperature to yield a liquid and a solid phase. The solid material can then be separated from the liquid phase, with improved results if the inverse critical temperature is maintained until the separation is complete.

C032
PRODUCTION OF NON-BULKING ACTIVATED SLUDGE,

Spector, M. L.

Air Products and Chemical Products, Incorporated,
Allentown, Pennsylvania. (assignee)

United States Patent 4,056,465. Issued November 1, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 1, p 212, November, 1977. 1 fig.

A patent has been issued for a process which inhibits the proliferation of filamentous biomass in the activated sludge process. Recycled activated sludge is mixed with BOD-containing influent in an initial contact zone. Anaerobic conditions are maintained in the contact zone to provide an environment which is essentially free of nitrogen oxides and contains less than 0.7 ppm dissolved oxygen. The growth of nonfilamentous organisms which sorb BOD is thus favored. The mixed liquor then passes to an oxygenated zone where the dissolved oxygen content is at least 1 ppm to facilitate oxidation and removal of the BOD. The waste water then passes to a settling zone where the purified supernatant liquid is separated from the settled sludge. A portion of the settled sludge is returned to the initial contact zone for mixing with the BOD-containing influent.

C033
WASTE WATER VALVE,

United States Patent 4,057, 076. Issued November 8, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 2, p 428, November, 1977. 1 fig.

A patent has been issued for a waste water valve arrangement to be used in conjunction with a vacuum sewage disposal system. The valve arrangement includes a waste water collection chamber having: a waste water inlet; a closure member, to close the outlet passage and connect the collection chamber and the vacuum system; and a pressure-controlled device for operation of the closure system. A float, which is displaced by liquid level variations in the collection chamber, controls a pilot valve. The pilot valve is then used to control the vacuum in the sewage disposal system.

C034
SLUDGE CONCENTRATOR AND CONDITIONER,

United States Patent 4,062,776. Issued December 13, 1977. Official Gazette of the United States Patent Office, Vol. 965, No. 2, p 638-639, December, 1977. 1 fig.

A device for sludge concentration and conditioning has been patented. Sludge and a flocculating polymer are introduced into the large inlet of a conical contact chamber. The contact chamber includes baffles mounted lengthwise on the inside of the chamber and weirs set end-to-end around the inside wall of the cone. The chamber rotates to mix the sludge and polymer, producing floc and filtrate. The mixture passes through a small outlet and into a conical screen drum through a large inlet. The conical screen drum, or concentrator chamber, rotates on a slightly inclined vertical support. The mixture's movement through the concentrator is slowed by a helical vane mounted on the inside of the drum. As the mixture moves toward the restricted outlet, the filtrate escapes through the screen of the chamber and floc is conveyed to the outlet by the drum's rotation and angle. A conduit connects the outlet of the contact chamber to the inlet of the concentrator.

C035
APPARATUS FOR TREATING SEWAGE SLUDGE,

O'Donnell, J. M.

Orgonics, Incorporated,
Slatersville, Rhode Island. (assignee)

United States Patent 4,057,392. Issued November 8, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 2, p 536, November, 1977. 1 fig.

A patent has been issued for a sludge treatment apparatus designed to produce a granular, high nitrogen product for use as animal feed or fertilizer. The particle size of the sludge filter cake is reduced on a continuous moving bed. A rotating raking reel shreds the filter cake; a rotating levelling reel evens out the bed of shredded sludge material; and the sludge is transported to a mixing area. A rotating shaft within an elongated vessel is used to agitate and homogenize the shredded sludge material. The vessel has inlet and outlet sections and the shaft is equipped with a number of paddles. Acidic material can be introduced into the reaction chamber of the mixing vessel and the temperature can be controlled within the range 30-80 C. An aqueous condensable methylol-prepolymer solution can also be added to the reaction vessel. The moisture content of the discharged reaction product is reduced to less than 10%. The mixture can be screened to the desired particle size.

C036

PURIFICATION OF WASTE WATER,

Australian Patent 485,192. Issued August 4, 1977. The Australian Official Journal of Patents, Trademarks, and Designs, Vol. 47, No. 28, p 2569, August, 1977.

A patent has been issued for a separation technique to be used with waste water containing a water-insoluble liquid with a specific gravity lower than water and a water-insoluble liquid with a specific gravity higher than water. The method utilizes a gravity separator with a tilted-plate, laminated assembly. Waste water in the form of a colloid or finely dispensed state is introduced into the separator. Warm water is added to the waste water to provide sufficient heat to compensate for the temperature loss in the waste water while in the separation assembly. Floc precipitation is thereby prevented at least until the waste water leaves the assembly.

C037

DEEP SHAFT BIOLOGICAL PURIFICN. OF WASTE WATER--WITH CIRCULATORY DRIVING FORCE GAS TAILORED TO POLLUTION INTENSITY,

Netherlands Patent NL 7705-308. Issued November 16, 1977. Derwent Netherlands Patents Report, Vol. Y, No. 48, p 4, January, 1978.

A method of deep shaft waste water treatment using forced air or gas circulation has been patented. The liquid is circulated by air that is driven through a riser passage which is larger in diameter at its lower end than at its upper end. The velocity of the liquid through the upper area of the riser passage should be about 1.2-1.5 m/sec. In the lower section of the downflow passage, oxygen-bearing gas is forced into waste water which moves at about 1.3-2.0 m/sec. The liquid passes through the lower part of the riser passage at a rate of at least 0.6 m/sec. The rate of oxygenation can be adjusted according to the waste strength. The addition of more oxygen to control the BOD in waste water with low pollutant levels is unnecessary because of the greater degree of circulation achieved by the design of the passage cross-sections.

C038

SEWAGE WASTE BIOLOGICAL TREATMENT DEVICE--HAS HORIZONTAL ROTOR WITH SPOKED ARMS TO CONTROL DISCHARGE OF SOLID WASTE,

German Patent DS 2500-031. Issued November 17, 1977. Derwent German Patents Abstracts, Vol. Y, No. 47, p 4, January, 1978.

A patent has been issued for a device to control solid waste discharge during biological sewage treatment by composting. Waste material enters the vertical compartment of a compost preparation tank through an inlet at the top. The discharge system, located at the bottom of the composter, contains one or more radial shafts mounted on a pivot. Radial discharge bolts which are located along the length of the shaft's periphery extend into the discharge mechanism. Support struts, which form the sides of the discharge hole, are located between the shafts, with the inner ends secured to the shaft butt. A bearing ring which joins the outer ends of the support struts is attached to a gear rim. A hydraulic drive ratchet, connected to the gear rim, operates the frame.

C039

DIFFUSING GAS INTO LIQ., ESP. AERATING WASTE WATER--WITH SYNERGISTIC REDUCTION IN ENERGY REQUIRED FOR MASS TRANSFER OPERATION,

Belgian Patent BE 854-872. Issued November 21, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 47, p 4, January, 1978.

A waste water aeration system displaying a synergistic reduction in the quantity of energy required for mass transfer has been patented. The system includes a hollow bell which rotates on a vertical axis at the lower end of a coaxial shaft attached at the apex of the bell. The angle of the bell's apex is at least 130 degrees; the symmetrical base angles are at least 60 degrees. Outlets located around the circumference of the bell's base discharge gas. Waste water is pumped along the axis over the top of the bell. The liquid is aerated as it passes over the gas outlets along the sides, creating a shearing effect through interfacial turbulence between the gas and liquid. This shearing action reduces the contacting resistance of the interfacial films. The process is effective in aeration during biological waste water treatment, especially for the activated sludge process.

C040

ELECTROLYTIC FLOCCULATION PLANT--ESP. FOR ACTIVATED SEWAGE SLUDGE PROCESSING,

German Patent DS 2259-020. Issued November 17, 1977. Derwent German Patents Abstracts, Vol. Y, No. 47, p 2-3, January, 1978.

A process for the treatment of sludge using electrolysis has been patented. Sludge is fed into a flotation cell which has inlets for sludge and outlets for the treated water. A uniform surface scum layer and more efficient water drainage are created by the homogeneous flow conditions within the cell. The

C023

HEAT EXCHANGE METHOD FOR WET OXIDATION SYSTEMS,

Van Kirk, J. W.

Whirlpool Corporation,
Benton Harbor, Michigan. (assignee)

United States Patent 4,053,404. Issued October 11, 1977. Official Gazette of the United States Patent Office, Vol. 963, No. 2, p 623, October, 1977. 1 fig.

A continuous wet oxidation process has been patented for use with organic waste sewage. The process includes treatment of the sewage in a reactor at 550-560 F and pumping of the waste sewage through two heat exchangers. The treated liquid is passed from the reactor through the second heat exchanger, through a throttling device, and then through the first heat exchanger in the series. The pressure of the effluent upstream from the throttling device maintains the pressure in the second heat exchanger at about 1500-1600 psi and the temperature at about 560 F. The pressure downstream from the throttling device and in the first heat exchanger is maintained at less than 500 psi and the temperature at no more than 400 F. The influent waste sewage is thus preheated in two stages before entering the reactor. The first stage is carried out at a lower temperature and pressure in the first heat exchanger, and the second at a higher temperature and pressure in the second heat exchanger.

C024

METHOD AND SYSTEM FOR WASTE TREATMENT,

Donnelly, L. A., Flocke, L. C., Himel, V. H., Mikals, J. J., and Munier, A. E.

Grumman Aerospace Corporation,
Bethpage, New York. (assignee)

United States Patent 4,053,399. Issued October 11, 1977. Official Gazette of the United States Patent Office, Vol. 963, No. 2, p 621-622, October, 1977. 1 fig.

In a process which has been patented for treating raw sewage, the influent is first screened to separate out the solid materials. The screenings are then incinerated. The screened waste fluid passes through a centrifuge system for separation into sludge and clarified liquid. The sludge is incinerated and the clarified liquid passes to a contact zone where ozone bubbles produce foam-entrapped solids, solids which adhere to ozone bubbles, and a disinfected liquid. The disinfected liquid is removed from the system and the foam-entrapped solids and bubble-held solids are incinerated.

C025

SEWAGE CHANNEL BAR SCREEN RAKE--RAISABLE BY CHAIN ALONG REARWARD SWIVELLING CARRIER ON CANTILEVER WITH POWER CYLINDER DRIVE,

German Patent DS 2524-776. Issued October, 20, 1977. Derwent German Patents Abstracts, Vol. Y, No. 43, p 4, December, 1977.

A patent has been issued for a channel bar screen rake which includes a collecting rake mounted at the influent end of a waste water treatment plant. A comb is placed parallel to the rectilinear rake and on its downstream side so that the teeth of the comb extend upstream through the rake. The direction of the comb teeth can be reversed to allow cleaning of the mechanism. The rake structure is equipped with a comb support which allows sliding and pivoting of the rake in a downstream direction as well as vertical motion of the comb within its support plane. A cantilever arm with a length equal to the protruding length of the comb teeth from the support is mounted on the downstream side of the support to allow pivoting.

C026

REMOVING PHOSPHATES FROM EFFLUENT BY THE ACTIVATED SLUDGE PROCESS--WITH COUNTERCURRENT EXTN. OF THE PHOSPHATE CONTG. SLUDGE,

French Patent ZA 7605-966. Issued August 2, 1977. Derwent French Patents Abstracts, Vol. Y, No. 43, p 3, December, 1977.

A patent has been issued for an activated sludge process to remove phosphate from BOD-containing waste water. The phosphate-containing influent is mixed with activated sludge and oxygen-containing gas in an aeration zone. Mixing facilitates the reduction of the BOD content of the influent and the removal of phosphate by microorganisms present in the activated sludge. The phosphate-enriched sludge is separated from the phosphate-free liquid in the mixed liquor and passed to an anaerobic stripping zone for release of the phosphate into the remaining liquid. The phosphate-enriched liquid is withdrawn from the upper section of the stripping zone while the phosphate-depleted sludge is recycled to the aeration zone. The process has been improved through the addition of counter-current stripping of the sludge phosphate by maintaining the sludge in the stripping zone for a period of 2-10 hours. A low phosphate, low solids stripping medium which is added to the lower section of the stripping zone flows up through the settling solids. Phosphate from the settling solids is then transferred to the stripping medium. The stripping medium should have a suspended solids concentration of less than 200 mg/liter and should be introduced at a flow rate of 0.7-2.0 times the rate that the phosphate-enriched liquid is withdrawn.

C021
GRAVITY DRAINAGE FILTER FOR SEWAGE SLUDGE ETC.--HAS SIMPLE UNBLOCKABLE OUTLET FOR DISCHARGING DEHYDRATED SLUDGE,

Belgian Patent BE 854-385. Issued September 1, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 36, p 3, October, 1977.

The gravity drainage filter which has been patented consists of a vertically suspended, flexible tube of porous material such as textile fabric. The bottom of the fabric sleeve can be closed to form a container into which the sludge is poured, and is equipped with a dehydrated sludge outlet which can be opened to a diameter equal to the full width of the sleeve. The sleeve extends below the container bottom which is created by the clamping of internal and external rigid reinforcing rings. The sleeve extension is folded back onto itself to form an annular pocket, with the outer edge of the pocket forming a border which is attached to a mobile support ring. Opening and closing of the container bottom is accomplished by rotation of the mobile support ring relative to the reinforcing rings.

C022
SCUM REMOVAL SYSTEM FOR A SEWAGE SETTLING TANK,

McGivern, R. F.

Sybron Corporation,
Rochester, New York. (assignee)

United States Patent 4,054,520. Issued October 18, 1977. Official Gazette of the United States Patent Office, Vol. 963, No. 3, p 993-994, October, 1977. 1 fig.

Details of a patent for a scum removal system for sewage settling basins are presented. The system includes a scum trough along the end wall of the basin, a floating beach, and a skimmer assembly. The floating beach extends along the full length of the scum trough and is connected to the trough by a hinge at the upper edge, so that part of the beach extends into the settling tank liquid. The beach has a raised area between the settling basin side and the hinge side to prevent flow into the scum trough. The skimmer assembly moves back and forth across the settling tank, pushing scum towards the trough, and can pivot to push the floating material over the beach into the trough. The depth and distance over which the skimmer assembly travels is adjustable. A modified system includes a time-delay mechanism which can delay the motion of the skimmer back and forth across the tank.

C027

AERATION TANK FOR ACTIVATED SLUDGE TREATMENT OF WASTE WATER-- IS SMALLER AND REQUIRES LESS POWER FOR A GIVEN TREATMENT CAPACITY,

French Patent ZA 7605-207. Issued August 31, 1977. Derwent French Patents Abstracts, Vol. Y, No. 43, p 1-2, December, 1977.

A basin for aerating mixed liquor in an activated sludge system has been patented. The basin consists of an elongated, rectangular tank equipped with inlet and outlet ends. Means for supplying waste water and recycled sludge to the tank are provided. Aerator units are located at various intervals along the length of the basin to aerate the mixed liquor as it flows through the tank to the outlet end. Staggered partitions extend from alternate side walls across at least part of the width of the tank to form liquid passes with a length to width ratio of 0.59-1.70. The liquid flow paths created by the partitions encompass 30-80% of the wetted cross-sectional area of the basin. The aerator units should have mixing factors within the range of 20-450. The partitioning creates an effect of liquid staging with more than one liquid stage per actual liquid pass.

C028

ELIMINATION OF NITROGEN CPDS. FROM WASTE WATER--BY DOWNWARDS PASSAGE THROUGH BIOLOGICAL TREATMENT UNITS IN A SUITABLE ATMOS.,

French Patent FR 2336-354. Issued August 26, 1977. Derwent French Patents Abstracts, Vol. Y, No. 43, p 5, December, 1977.

A biological treatment process has been patented for the removal of organic nitrogen compounds, nitrates, nitrites, and ammonium compounds from waste water. A pipe conducts the waste water into a distribution chamber and then through a series of superimposed units for the removal of oxygen and the biological reduction of nitrates. The waste water then passes into an evacuated gas distribution chamber where nitrogen is introduced through a tube in a reverse direction to that of the waste water flow. The superimposed units are filled with innoculated porous media which have been treated with a nutrient suitable for supporting nitrifying bacteria. Overflow tubes conduct waste water from one unit to the next in the column.

C029

VERTICAL AXIS AERATING ROTOR FOR WASTE WATER--CAN BE OPERATED AT HIGHER SPEEDS THAN PREVIOUS INVERTED CONE TURBINE ROTORS,

French Patent FR 2337-580. Issued September 9, 1977. Derwent French Patents Abstracts, Vol. Y, No. 45, p 3, December, 1977.

A patent has been issued for a high-speed rotor for waste water aeration. The rotor consists of a flat, preferably circular, plate which rotates in a horizontal plane about a vertical axis. The underside of the rotor is equipped with several, angularly spaced blades which extend radially toward the periphery of the rotor. The blade depth is shallowest at the blade's ends, yielding a crescent shape. Each blade is fitted with a wing-like plate which extends from both sides of the blade's crest to its outer edge. The blade itself extends beyond the perimeter of the circular rotor. Four right-angle vertical plates which coincide with the central axis of the rotor act as baffles to prevent turbulence in the lower section of the tank. The rotor can reportedly be operated at higher speeds than conventional inverted cone turbine rotors.

C030
ACTIVATED SLUDGE PROCESS,

Hasegawa, T., and Hasegawa, S.

Seisuikogyo Company, Limited,
Osaka, Japan. (assignee)

United States Patent 4,055,490. Issued October 25, 1977. Official Gazette of the United States Patent Office, Vol. 963, No. 4, p 1323, October, 1977. 1 fig.

A patent has been issued for an activated sludge process which employs an aeration tank having a narrowed, discharge conduit at its upper end. Waste water is introduced into the tank; and an oxygen-containing gas is added at the bottom of the tank. The gas flows up through the tank to the discharge conduit and in the process agitates and aerates the waste water. The activated sludge adheres to a number of free-floating, spongy particles in the tank. An air lift effect causes the particles to be lifted toward the discharge conduit. The spongy particles are periodically allowed to exit the tank via the discharge conduit. The spongy pieces then pass to a head tank equipped with pressing rolls. The sludge is extracted and the spongy pieces are prepared for recycling to the aeration tank.

C031
METHOD OF DEWATERING MATERIAL CONTAINING SOLID MATTER AND BOUND AND UNBOUND WATER,

Peters, H. H.

Resources Conservation Company,
Renton, Washington. (assignee)

United States Patent 4,056,466. Issued November 1, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 1, p 212, November, 1977. 1 fig.

A chemical process for dewatering sludge has been patented. The dewatering process is based on the mixture of an amine with the sludge. The amine con-

C045

AEROBIC SEWAGE TREATMENT SYSTEM,

Australian Patent 487,544. Issued October 27, 1977. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 47, No. 40, p 3642, October, 1977.

A patent has been issued for a divided aeration tank which provides automatic sewage treatment with low maintenance for individual domestic use. The unit employs an aeration tank with a perforated divider forming two aeration chambers. Raw sewage enters the first aeration chamber through an inlet and passes into the second aeration chamber. An airlift pump in the second chamber continuously pumps sewage and waste water into a separate tank for settling and maintains a constant level of fluid just below the sewage inlet. Liquid level maintenance by the airlift pump enables the aeration tank to withstand shock hydraulic loads. The separate settling tank is equipped with several settling acceleration plates, slanted in the direction of the aeration tank, which transfer effluent to a filter bed.

C046

METHOD AND APPARATUS FOR WASTE WATER TREATMENT,

United States Patent 4,064,047. Issued December 20, 1977. Official Gazette of the United States Patent Office, Vol. 965, No. 3, p 1050-1051, December, 1977.

A patent has been issued for an ozone absorption chamber and process for the treatment of waste water. The closed ozonization tank is equipped with a spray nozzle and outlet which connects the interior of the chamber with the exterior. The nozzle is installed in an electrically grounded interior wall with a conductive surface. A waste water inlet attached to the spray nozzle conveys waste water to the chamber under controlled pressure. Before the waste water is released into the chamber, it receives an electrical charge. The water is distributed over the grounded inner wall in the form of a non-atomized spray which transfers its electrical charge to the electrically grounded wall upon contact. Pressurized ozone is then pumped through an inlet from the exterior of the chamber into the waste water for thorough mixing. After ozonization is completed, waste water is removed from the chamber through an outlet.

C047

SEWAGE PURIFICATION SYSTEM,

United States Patent 4,059,521. Issued November 22, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 4, p 1263, November, 1977. 1 fig.

A waste treatment system which combines aeration, digestion, and settling has been patented. Untreated liquid waste is passed through a series of closed, elongated tanks having horizontal axes placed end-to-end. Digestion of sludge in the first tank is accomplished through agitation of the waste and a separate aeration device. The treated sewage then passes into the second tank where solids are settled. A third closed collection tank is positioned at the lower portion of the second tank to receive the settled sludge. Suspended solid waste materials are further removed from the settled sewage in the third tank and are returned with the suspension component to the first tank for reagitation, reaeration, and continued digestion. The purified liquid separated from the settled sludge in the third tank is collected in another elongated tank from which the liquid is discharged into the ground.

C048

DEVICE FOR THE PURIFICATION OF WASTE WATER,

United States Patent 4,062,911. Issued December 13, 1977. Official Gazette of the United States Patent Office, Vol. 965, No. 2, p 671, December, 1977. 1 fig.

A patent has been issued for a waste water aeration device using the activated sludge method. The aeration device consists of a rectangular tank which has a partition placed parallel to and equidistant from the two longer walls of the tank. The partition should be shorter than the two long walls, thus forming a loop through which the waste liquid is moved. One or more surface aerators are installed near one of the longer walls. The body of the aerator rotates on a vertical axis, causing the waste water to flow around the loop formed by the tank walls and the partition. Baffles upstream of the aerator are positioned perpendicular to the longer walls. The baffles are of a length that will not obstruct the flow of the waste liquid when the baffles are in position.

C049

AUTOMATIC SLUDGE EXTRACTION AND WASHING DEVICE FOR USE IN A WATER TREATMENT SETTLING APPARATUS,

Tardivel, J.

Societe Degremont,
Rueil-Malmaison, France. (assignee)

United States Patent 4,059,531. Issued November 22, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 4, p 1266-1267, November, 1977. 1 fig.

An automatic method for the washing and extraction of sludge during settling treatment has been patented. The washing and extracting device is installed in a sludge settling bed contained in a decanter which has a sludge concentrator for removing settled sludge. One end of a siphon is introduced into the concentrator of the tank; the other end is connected to a manifold conduit which transports fluid to a sludge removal station. A valve connecting the siphon with a vacuum source controls the opening and closing of this channel. A second valve connects the siphon to the atmosphere; a third valve controls the opening and closing of the channel between the manifold conduit and the fluid source; a fourth valve opens or closes the channel between the manifold and the sludge removal station. When the first and fourth valves are in the open position and the second and third are in the closed position, a vacuum is used to extract the sludge from the concentrator into the siphon. The sludge is then transported through the manifold conduit to the sludge removal station. The washing process is achieved by reversing the extraction process. The first and third valves are set in the open position while the other two valves are closed. Fluid is introduced into the manifold conduit where it is drawn by the vacuum into the siphon. The fluid passes through the siphon into the concentrator where the fluid washes the concentrator and overflows, washing the bottom of the decanter.

C050

METHOD OF AND APPARATUS FOR DIGESTING ORGANIC WASTE AND/OR SEWAGE SLUDGE,

Kneer, F. X.

Gebruder, Weiss K. G.,
Dillenburg, Germany. (assignee)

United States Patent 4,062,770. Issued December 13, 1977. Official Gazette of the United States Patent Office, Vol. 965, No. 2, p 636-637, December, 1977. 1 fig.

An aeration unit for the continuous digestion of organic waste has been patented. The organic waste or sewage sludge is fed through an inlet to the upper portion of a vertically-positioned closed tank. The waste moves through the digestion tank in a continuous, single mass toward the outlet at the lower end of the tank. It is aerated along the entire cross-section of its mass as it passes toward the lower end of the tank. Sensors in the tank compare the moisture content, temperature, and air pressure in the waste with a predetermined set of desired values. The air, which moves in the opposite direction of the downflowing waste mass, is removed by a vacuum from the upper end of the tank and analyzed for carbon dioxide and oxygen content. The air removal system also controls the pressure of the air released into the waste mass Monitors in the upper and lower portions of the tank compare the moisture content of the air with a predetermined set of values. The air moisture is controlled by the injection of a fine spray of water; the air temperature is maintained between 30 and 50 C. A distributor, controlled by a blower, regulates the flow of air through the lower portion of the closed reactor tank.

C051

HORIZONTAL AXIS AERATING ROTOR FOR WASTE WATER TREATMENT--USES POLYGONAL ROTOR NODULES WITH ANGLED BEATER BLADES,

French Patent FR 2344-503. Issued November 18, 1977. Derwent French Patents Abstracts, Vol. A, No. 2, p 3-4, February, 1978.

A waste water aeration system with modular polygonal rotors and angled beater blades has been patented. Polygonal end plates forming coaxial modules are attached to a horizontal rotary shaft. The corresponding end plates are connected by flat stringer plates equipped with beater blades along the outer edges. The beater blades are all positioned at the same angle with respect to the rotary shaft's axis. Subsequent modules are fitted with increasingly angled beater blades, with increments of 15 degrees for each successive module. The maximum angle of the beater blades should be no more than 60 degrees. The hexagonal side plates are bent toward the center of the module. As the rotary shaft turns the module, the beater blades along the stringer plates mix the waste water. The water is oxygenated by the rotating beater blades as it passes through the biological treatment tank. It is suggested that beater blades are more easily installed on the flat surface of a polygonal rotor.

C052

SEWAGE SETTLING TANK WITH FLOATING SIPHON SYSTEM--HAS BAFFLES FORMING CLEAR WATER ZONE ABOVE TUBE SETTLERS,

French Patent FR 2344-502. Issued November 18, 1977. Derwent French Patent Abstracts, Vol. A, No. 2, p 3, February, 1978.

A patent has been issued for a waste water settling system which produces clarified water and siphons off settled sludge. The settling tank contains two or more banks of tube settlers located on a horizontal plane near the tank's bottom. Baffles, containing sealed floating carriage openings at one end, extend vertically from the settler banks to form a clarified water area. Water levels are maintained by outlets in the clear water zone. A siphon, supported by the floating carriage, extends horizontally between the settlers and removes sludge through inlets located on lateral branches. Untreated liquid is prevented by a seal from flowing through the carriage inlet in the baffle and into the clarified water zone. The clear liquid is removed through outlets located near the settling banks.

C053

ACTIVATED SLUDGE EFFLUENT TREATMENT--WITH EJECTOR AERATING/EFFLUENT CIRCULATING SYSTEM IN A TREATMENT TRENCH,

German Patent DS 2404-289. Issued December, 29, 1977. Derwent German Patents Abstracts, Vol. A, No. 2, p 3, February, 1978.

An effluent aeration and circulation tank to be used during activated sludge treatment of waste water has been patented. Gas-injecting aeration nozzles are mounted near the bottom of the activated sludge tank. A gas-fluid mixture is injected into the sewage sludge at an impulse density of 3-5 kilopascals to produce a sludge impulse density of 90-500 pascals. The gas-liquid injection nozzles are positioned asymmetrically with respect to the tank's cross section. This causes the activated sewage sludge to flow in a closed horizontal circuit within the tank. The columns of rising bubbles are rotated by the injected gas-fluid mixture. This motion prevents the settling of the activated sludge within the system during treatment.

C054

AEROBIC BIOLOGICAL PURIFICN. OF POLLUTED EFFLUENT--BY DISSOLVING OXYGEN AT PROGRESSIVELY INCREASING LIQ. PRESSURE,

Netherlands Patent NL 7706-126. Issued December 12, 1977. Derwent Netherlands Patents Report, Vol. A, No. 1, p 2, February, 1978.

A patent has been issued for a compact waste water aeration process using compression and decompression coils for increased oxygenation during biological treatment. The compression coil is a flat, spiral pipe which rotates about a vertical axis. Waste water is introduced into the center of the coil and the force of rotation draws the liquid towards the periphery of the coil. The pressure of the liquid increases to a maximum at the periphery of the coil; oxygen-bearing air is injected into the liquid as it passes through the coil At the periphery the effluent is passed to the outside of a decompression coil. This coil also rotates around a vertical axis, preferably attached to the same drive shaft and rotating coaxially with the compression coil. The liquid passes from the outside of the decompression coil. The liquid passes from the outside of the decompression coil towards its interior axis, decreasing in pressure as it approaches the central outlet. A portion of liquid-entrained sludge is removed from the decompression coil before it passes through the outlet and is returned to the compression coil. The purified liquid from the decompression coil is passed through a degassing device before discharge.

C055

BAND PRESSURE FILTER FOR DEHYDRATING WASTE WATER SLUDGE ETC.--HAS POWER CYLINDER BAND TENSIONING TO COMPENSATE FOR CAKE THICKNESS VARIATION,

Netherlands Patent NL 7705-632. Issued December 13, 1977. Derwent Netherlands Patents Report, Vol. A, No. 1, p 2, February, 1978.

A patent has been issued for a pressurized sludge filtration and dewatering system. A set of filter bands is positioned on a series of rollers which rotate in alternate directions. The sequential rollers have diminishing diameters; the first roller has a diameter five times greater than that of the next two rollers and twice that of the fourth and fifth rollers. The rollers, which are positioned to hold the filter bands in tension, are mounted on pivoting arms whose axes are rotated by power cylinders. The cylinders are provided with actuating liquid at a pressure equal to the pressure of the tension rollers. The sludge is dewatered as it is pressed between the bands and the rollers. As the bands rotate around the rollers, one band acts as a filtering device while the other applies pressure. Since the bands remain taut, sludges of differing thicknesses are allowed to pass between the bands for dewatering.

C056

BIOLOGICAL EFFLUENT PURIFICATION AND CLARIFICATION EQUIPMENT--WITH AERATORS, FLOTATORS AND SCRAPER CONVEYOR TO REMOVE ACTIVATED SLUDGE WHICH IS THICKENED,

Soviet Patent SU 548-574. Issued March 14, 1977. Derwent Soviet Inventions Illustrated, Vol. 8, No. 1, p 3, February, 1978. 1 fig.

A patent for a biological treatment unit with an activated sludge removal and thickening system is presented. Effluent is drawn through an intake pipe into the activated sludge tank where it is mixed by automatic intake aerators. Flotators, located in the bottom of the tank, separate the activated sludge by injecting it with air bubbles which rise to the surface as the liquid passes through the distribution system. The clarified liquid is transferred to a trough where it overflows into an intermediate collection tank. Partial recirculation of the clarified liquid is accomplished by a pump; the remainder of the water passes through outlets for further processing. A scraper mechanism removes the excess activated sludge and thickens it before transferring the sludge into gulleys for removal to additional treatment processes. The activated sludge is thickened by hollow, cylindrical elements located above the flotators.

C057

WASTE WATER FLAME DECONTAMINATION--BY DIVIDING HIGH TEMP. COMBUSTION PRODUCTS INTO NUMBER OF STREAMS CORRESP. TO NUMBER OF CONTROL STAGES,

Soviet Patent SU 548-749. Issued March 30, 1977. Derwent Soviet Inventions Illustrated, Vol A, No. 1, p 3, February, 1978. 1 fig.

A combustion system for the decontamination of organic and mineral-bearing waste water using steam, gas, and high-temperature combustion products of the treatment process has been patented. After incineration in a furnace, high temperature combustion products are separated into a number of streams equal to the number of control treatment stages. These high temperature streams are used in combustion chambers to oxidize steam and gas mixtures produced in the previous control stage. Thus, one stream of high temperature combustion material is combined with waste water in one control stage to produce a steam/gas mixture. This steam/gas mixture flows into a combustion chamber where it is oxidized by another stream of high temperature combustion products. The hot gases produced in this stage are passed onto the second stage which repeats the process. The process is repeated a total of three times, producing a final effluent containing non-volatile organic material and mineral impurities. This effluent is returned to the initial furnace for incineration and repetition of the entire process cycle.

C058

DEWATERING OF WASTEWATER TREATMENT WASTES,

Ramirez, E. R.

Swift and Company,
Chicago, Illinois. (assignee)

United States Patent 4,071,447. Issued January 31, 1978. Official Gazette of the United States Patent Office, Vol. 966, No. 5, p 1873-1874, January, 1978. 1 fig.

A patent has been issued for a process to dewater effluent treatment wastes, such as sludges or skimmings, using aeration and a vertical column. Coagulated waste resulting from primary treatment or precipitation is introduced into the lower inlet of a vertical chimney. An aerator, located below the waste inlet, supplies air bubbles to the dispersed wastes. A polymer flocculant is added, below the waste inlet and above the aeration source, to bring about the formation of buoyant composites with the coagulated materials in the waste. These buoyant composites are confined within the vertical column by the limitation of horizontal movement. The waste-bearing air bubbles move upwardly through the vertical chimney, forming an upper stratum of impurities. The lower stratum within the vertical column, containing clarified water, is separated from the waste-bearing upper stratum.

C059

DEWATERING SLUDGE CONTAINING SOLID MATTER AND BOUND AND UNBOUND WATER,

Australian Patent 488,609. Issued December 8, 1977. The Australian Official Journal of Patents, Trademarks, and Designs, Vol. 47, No. 46, p 4168, December, 1977.

A process using an amine to dewater sludge consisting of solid materials and water has been patented. The technique involves mixing an amine containing an alkyl or hydrogen, an alkyl radical with one to six or two to six carbon atoms, and a total number of carbon atoms from three to seven, with the sewage sludge. The temperature is maintained below the inverse critical solution temperature of the amine. The reduced temperature causes the formation of a solid and a liquid which contains the amine and the water. After separation of the liquid and solid phases, the temperature of liquid phase is raised to above the critical solution temperature, thereby separating into an amine and a liquid. The amine is removed from the water and mixed with an alkaline solution containing lithium hydroxide, sodium hydroxide, potassium hydroxide, calcium hydroxide, and a lithium, sodium, or potassium salt of a weak acid solution. The addition of a hydroxide solution reduces the residual amine in the solid.

C060

WASTE TREATMENT PLANT,

Australian Patent 488,148. Issued November 17, 1977. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 47, No. 43, p 3920, November, 1977.

A waste water treatment tank that utilizes an aeration process and a settling basin has been patented. The tank is divided into two parts by an interior, centrally-located baffle. One side of the tank contains an aeration unit which aerates the waste water and maintains a continuous state of turbulence. The waste water passes into the aeration chamber of the tank through an inlet. After aeration, it is transferred by the interior baffle into the adjacent settling chamber containing an outlet. The waste water undergoes settling in this chamber; scum is recovered from the waste and recirculated to the aeration chamber via a recirculation device.

C061

METHOD AND DEVICE FOR THE WET COMPOSTING OF ORGANIC SLUDGE,

United States Patent 4,072,494. Issued February 7, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 1, p 207-208, February, 1978.

A continuous flow, wet composting method for organic sludge treatment has been patented. Oxygen-bearing gas is introduced into sludge contained in an air-tight mixing tank. A composting reaction is promoted as the oxygen is passed

C075

SONIC CAVITATION AND OZONATION OF WASTE MATERIAL,

Bybel, D., Bellmore, N., Furey, R. F., and Stahl, D. P.

TII Corporation,
Lindenhurst, New York.

United States Patent 4,076,617. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1569, February, 1978. 1 fig.

A patent has been issued for a waste water treatment process which employs acoustic energy and ozone. The liquid waste is introduced into a vessel equipped with diffusers for emitting a gas stream containing 0.5-1.0% ozone. The bubbles cover at least 90% of the cross-sectional area of the vessel and act as a barrier to divide the vessel into a lower treatment section and an upper ozone contact region. Acoustic energy is applied to the waste water in the lower section at a level sufficient to cavitate and emulsify the waste material. The material is then transferred to the upper section where it is contacted with the ozone-bearing gas stream.

C076

METHOD FOR TREATMENT OF DIGESTOR SUPERNATANT AND OTHER STREAMS IN WASTEWATER TREATMENT FACILITIES,

United States Patent 4,076,515. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1541, February, 1978. 1 fig.

A waste water treatment process to remove ammonia from the supernatant of anaerobically digested sludge has been patented. The waste water sludge is thickened and placed in an anaerobic digester where the organic materials are converted to methane and carbon dioxide; the nitrogen in the sludge is converted to ammonia. The digester supernatant is decanted from the tank; the digested sludge is dewatered by vacuum filtration. The dewatering liquor, containing water soluble ammonia, is mixed with the supernatant. The mixture is then reacted with a stoichiometric excess of lime. The ammonia salts contained in the supernatant and dewatering liquor are converted to aqueous or free ammonia which is contacted in a reactor with steam under low pressure. The ammonia is thus reduced to a less soluble form. The digested sludge is dried for use as fertilizer.

C077

PROCESS FOR THE BIOLOGICAL PURIFICATION OF SEWAGE,

United States Patent 4,076,616. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1569, February, 1978. 1 fig.

A patent has been issued for a biological treatment process using activated carbon and oxygenation. Sewage percolates through an activated carbon bed submerged in a tank. The activated carbon particles have a size range of 1.5-8.0 mm. Oxygen-bearing air is injected into an intermediate layer of the activated sludge bed, aerating only that portion of the activated carbon above that layer. The waste water percolates through the activated carbon bed at a rate less than 2 m/hr, providing a contact time in the layer above the intermediate level of 30 min or more. The lower levels of the activated carbon bed are free of bacterial colonies. Bacteria are retained within the intermediate layer as the waste water percolates through.

C078

PROCESS AND SYSTEM FOR TREATING WASTE WATER,

Olesen, D. E., and Shuckrow, A. J.

Battelle Pacific North West Laboratories,
Richland, Washington. (assignee)

United States Patent 4,076,615. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1568-1569, February, 1978. 1 fig.

A patent has been issued for a combined powdered activated carbon-aerated biological treatment process to remove dissolved organic substances from waste water. Waste water is introduced into an oxygen aeration chamber containing 50 mg/liter powdered activated carbon and 100 mg/liter alum. The organic particles are adsorbed onto the carbon which is coagulated by the alum. Alum is precipitated as aluminum hydroxide by pH adjustment. Sludge and supernatant are produced with the addition of a polyelectrolyte flocculant; the sludge is aerated to enhance microbial degradation of the organic substances. Thermal regeneration of the sludge reactivates the carbon and converts the aluminum hydroxide to alumina. A portion of the activated sludge is returned to the initial aeration chamber for mixing with influent; the remainder is acidified with sulfuric acid to convert the alumina to alum. The sludge containing the reactivated carbon and alum is recycled to the aeration chamber for contact with the incoming waste water.

C079

WARM SLUDGE DIGESTION WITH OXYGEN--USING OFF-GAS FOR TREATMENT OF WASTEWATER,

German Patent DS 2528-800. Issued February 2, 1978. Derwent German Patents Abstracts, Vol. A, No. 6, p 4, March, 1978.

A patent has been issued for a temperature-controlled sludge digestion process with off-gas aeration. A mixture of effluent and activated sludge is aerated with gas containing at least 40% O2 to yield a dissolved oxygen concentration of 0.5 mg/liter in the mixture. The temperature of the covered aeration tank is maintained above 15 C during mixing; activated sludge, clarified liquid, and unused O2 are then decanted from the tank. The excess activated sludge is aerated in an enclosed degradation chamber with a gas containing at least 80% O2 at a temperature of 25-75 C. The total solids in the slurry are maintained above 1,500 mg/liter and the temperature 10 C higher than the temperature in the aeration chamber. Dissolved oxygen is maintained at 2 mg/liter to degrade at least 60% of the volatile suspended solids. Stabilized sludge residue and depleted O2 gas are drawn off after the desired decomposition level is achieved. The depleted gas with an O2 content of at least 40% is recycled to the initial aeration stage. This feed gas is withdrawn at a rate that reduces the O2 concentration to at least 35%. Similarly, the gas from the aeration tank contains less than 40% O2 by volume, controlled by the withdrawal rate. The process, which effectively reduces BOD, conserves energy via oxygen reuse.

C080

SEWAGE PURIFICN. PLANT FOR SMALL COMMUNITIES--OPERATING BY EXTENDED AERATION WITH GLASS WOOL MAT TO IMPROVE OXIDN.,

French Patent FR 2347-313. Issued December 9, 1978. Derwent French Patents Abstracts, Vol. A, No. 5, p 4-5, March, 1978.

An extended aeration sewage treatment plant which uses a glass wool layer to diffuse air bubbles for small waste loads has been patented. The sewage treatment plant is a conical tank divided into a decantation zone containing a layer of glass wool coated with a polyester resin and an oxidation zone near the inside of the tank. Waste water is introduced into the base of the oxidation zone where air bubbles are supplied by a compressor. The waste passes into the decantation zone which is partitioned into four cells with walls bearing alternating top and bottom holes. Activated sludge and other heavy matter is separated and recirculated through the holes and is retained on the glass wool. Bulked sludge floats with the air bubbles to the surface of the tank through the upper cell of the decantation tank. The clarified liquid is free of suspended solids; the oxidation yield is high.

C081

BIOLOGICAL MICROORGANISM ACTIVITY CONTROL--IN SEWAGE TREATMENT BY COMPUTER FED WITH OXYGEN CONC., TEMP., PH AND TURBIDITY READINGS,

German Patent DS 2532-199. Issued February 23, 1978. Derwent German Patents Abstracts, Vol. A, No. 9, p 3, April, 1978.

A patent has been issued for a computerized method to control the biological treatment of waste water with respect to the quality of the effluent. The treatment process utilizes an aeration reactor, a clarification tank, and a secondary sludge aeration chamber. Oxygen concentration, turbidity, pH, temperature, and flow rate of the waste water into the aeration reactor are monitored by a computer. The biological activity of the microorganisms in the waste water is measured according to the temperature-dependent oxygen demand value obtained automatically from oxygen and turbidity data. The pH in both reactors is maintained at the desired value via additions of alkaline or acidic solutions. Variations in the specific oxygen demand, which directly relates to the microbial activity, are automatically controlled by adjustments in the inflow rate, aeration rate, and composition of added nutrients in the waste solution in one or both reactors.

C082

MOBILE SLUDGE TRAILER AND METHOD OF FILLING AND EMPTYING SAME,

Petroski, A.

Liquid Removal Service Company, Incorporated,
Broomall, Pennsylvania. (assignee)

United States Patent 4,082,672. Issued April 4, 1978. Official Gazette of the United States Patent Office, Vol. 969, No. 1, p 272, April, 1978. 1 fig.

A patent has been issued for a mobile sludge trailer designed to transport partially biodegradable sludge. A double-frusto conical tank, divided into two bilateral symmetric sections by a vertical plane, is mounted on a trailer frame. The floor of the tank slopes down towards the bottom of the bisecting vertical plane and contains a sludge discharge apparatus. The inside of the tank contains circular baffles which are mounted parallel to one another and extend from the top peripheral edge of the tank parallel to the tank's floor. The baffles are positioned to form a sludge discharge chute. Discharge of the sludge from the trailer is assisted by pressurization of the head space in the tank to increase the pneumatic and hydraulic pressure at the sludge discharge apparatus. Fluid is injected under pressure into the tank near the discharge point. The fluid mixes with the sludge to facilitate sludge discharge. The trailer also has means for loading sludge into the trailer.

C083
INFILTRATION-INFLOW SEWER LINE ANALYZER,

United States Patent 4,070,563. Issued January 24, 1978. Official Gazette of the United States Patent Office, Vol. 966, No. 4, p 1566-1567, January, 1978. 1 fig.

A patented infiltration-inflow sewer line analyzer with computer monitoring is described. Adjustable liquid pressure sensors are mounted at both ends of the sewer pipe. The sensors periodically monitor the sample liquid pressure between the sensors within the pipe and record the values. The recorded pressure values over a selected period of time are converted into liquid flow rates and fed to a computer. The computer is programmed with dry weather and rain flows within the pipe section as supplied by the monitors. Dry and wet weather flow rates monitored at one end of the pipe are compared by the computer with the same timed measurements at the other end of the sewer pipe. Rainfall inflow and infiltration rates in the pipe are measured and compared by the computer with previously collected rainfall and dry weather values.

C084
SANITARY WASTE TREATMENT PLANT,

Australian Patent 487,761. Issued November 3, 1977. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 47, No. 41, p 3738, November, 1977.

A patent has been issued for a biological treatment system which incorporates sanitary waste delivery and water recovery. Sanitary waste is transported to the treatment facility by the delivery system. Water used by the delivery system for the transport of wastes to the biological treatment unit is supplied by the water recovery system. The sanitary wastes are degraded in a biological treatment apparatus and treated effluent is transported to the water recovery system. The effluent is passed through a semi-permeable membrane for solids separation. A portion of the solids is returned to the biological treatment for further degradation. The liquid fraction and the remaining effluent concentrate are refiltered through the membrane for further clarification. The permeate is returned to the delivery system for the transport of sanitary wastes to the biological treatment plant.

C085
WASTE WATER TREATMENT WITH OXYGEN,

Abrams, E., and Masella, A. J.

Chemetron Corporation,
Chicago, Illinois. (assignee)

United States Patent 4,069,147. Issued January 17, 1978. Official Gazette of the United States Patent Office, Vol. 966, No. 3, p 1114, January, 1978.

A biological waste treatment process which effectively reduces the oxygen requirements during microbial degradation has been patented. Waste water with a high BOD concentration is mixed with a biologically active mass which metabolizes BOD. The BOD of the influent is reduced by the activated mass without the need for extensive oxygenation. The BOD-rich biological activated mass and liquid are clarified and separated into the BOD-rich mass and clarified liquid. A portion of the activated mass is discharged and the remainder is transferred to an oxygenation tank where it is contacted with a gas containing 30% oxygen by volume. The oxygenation of the biological mass reactivates it before transfer back to the initial waste water mixing tank.

C086
APPARATUS FOR TREATING SEWAGE,

Adams, L. R.

American Water Recycling Company,
Apache Junction, Arizona. (assignee)

United States Patent 4,070,292. Issued January 24, 1978. Official Gazette of the United States Patent Office, Vol. 966, No. 4, p 1494, January, 1978. 1 fig.

An extended aeration system providing continuous waste water treatment has been patented. A treatment tank with a curved end wall has a perforated transverse baffle which divides the tank into a primary chamber and a mixing chamber. The waste water is introduced into the primary chamber where it is aerated and pumped into the mixing chamber through the perforated baffle. The mixing chamber contains an inlet, an outlet, and an ejector mounted in a conduit for decanting liquid from the mixing chamber. The withdrawn liquid is discharged through the outlet towards the curved wall of the tank, establishing circular flow between the mixing tank and the primary tank. During the circular flow, the larger particles are retained within the primary tank where they are organically degraded. The clarified liquid from the mixing tank is removed by a separate pumping apparatus which transports the liquid to a storage tank for chemical disinfection.

C087
SYMBIOTIC MEMBRANE SYSTEMS,

United States Patent 4,080,288. Issued March 21, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 3, p 1092-1093, March, 1978. 1 fig.

A patent has been issued for a symbiotic membrane treatment system to remove liquid organic and inorganic waste from sewage effluent. Biological treatment of the waste water is enhanced by the presence of nitrogen and oxygen. Waste water introduced into the biomass in the reactor is maintained in an ambient atmosphere by the permeation of selected gases through a membrane which is located between the biomass and the gaseous phase in the reactor. The semi-permeable membrane, which allows the ambient gases for biological treatment to reach the biomass, maintains contact between the gaseous phase and the biomass for a period of time adequate for biological degradation of the organic and inorganic wastes. The treated biomass is then removed from the reactor.

C088
APPARATUS FOR TREATING WASTE WATER OR SOLUTION,

Kabara, K., Ogawa, T., Takahashi, S., Nishimura, S., and Kikawa, S.

Hitachi, Limited,
Tokyo, Japan. (assignee)

United States Patent 4,080,289. Issued March 21, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 3, p 1093, March, 1978. 1 fig.

A membrane separation apparatus for removing calcium and fluoride from a waste water stream has been patented. The waste water bearing the fluoride and calcium is initially pretreated before introduction into the membrane separation apparatus. An additive containing aluminum ions is mixed with the waste water. The aluminum ions cause the formation of water soluble fluoride complexes. The pretreated waste water bearing the soluble fluoride complexes is introduced into the membrane separation apparatus where the waste is separated into two fractions. The membrane separates the pretreated waste water into a permeated liquid fraction and a concentrated liquid fraction. Means are provided in the apparatus for introducing the waste water and the aluminum ion additive.

C089
METHOD FOR REMOVING PHOSPHATES FROM AQUEOUS SOLUTIONS,

Klantschi, K., and Aregger, A.

Chemische Fabrik Uetikon,
Uetikon am See, Switzerland. (assignee)

United States Patent 4,080,290. Issued March 21, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 3, p 1093, March, 1978.

A technique to selectively remove phosphorus from aqueous solutions and waste water has been patented. The phosphorus-bearing solution is initially contacted with a water insoluble complex of multivalent metal cations. The metal cations are complexed with organic ligands coordinated by treating the ligands with a salt solution of the multivalent metal cations. The organic ligand coordinated complex is then washed with water until the wash water no longer contains traces of the salt solution and has been neutralized. Phosphorus in the waste water or aqueous solution is adsorbed onto the coordination complex of multivalent metal cations.

C090
TANK FOR AGITATION AND AERATION OF SEWAGES,

Przybylowicz, R., and Zabierzewski, C.

Biuro Projektowo-Konstrulcyjne Centralnego Zwiazku
Spoldzielni Mleczarskich,
Warsaw, Poland. (assignee)

United States Patent 4,080,292. Issued March 21, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 3, p 1094, March, 1978. 1 fig.

A waste water aeration basin that provides both horizontal and vertical agitation has been patented. The basin consists of a rectangular tank equipped with turbine aerators which rotate around a vertical axis. The aerators are spaced around the interior of the tank, separated by vertical partitions. The partitions divide the aeration tank into two sections which are connected by adjacent ditches. The method of aeration uses a brush which rotates around a horizontal axis transversing the two ditches. Vertical and horizontal turbulence is generated by the aerators and brush in the waste water. The activated sludge in the treatment tank is thus maintained in suspension throughout the tank during aeration, ensuring even distribution of the microorganisms.

aerobic bacteria. Oxygen for degradation of the sewage slurry by the aerobic bacteria is generated by electrolysis which simultaneously generates hydrogen. The digester is enclosed to prevent the escape of oxygen; hydrogen is maintained separate from the oxygen in the digester. The bacteria are sustained in the presence of oxygen while the hydrogen is vented from the waste water treatment unit.

C105
PROCESS FOR DEWATERING ORGANIC WASTE PRODUCT,

O'Donnell, J. M.

Orgonics, Incorporated,
Slatersville, Rhode Island. (assignee)

United States Patent 4,081,366. Issued March 28, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 4, p 1456, March, 1978.

A dewatering process for treating sewage sludge in the presence of urea-formaldehyde has been patented. A urea-formaldehyde solution is reacted under alkaline pH to form water soluble, monomeric mono- and dimethylol ureas and excess urea. Waste activated sludge in an aqueous solution is reacted with the excess urea and water soluble, monomeric, methylol ureas at pH 7.0-9.0. An inorganic acid or acid salt is added to the mixture to lower the pH to 3.0-5.0 to condense the methylol ureas. The resulting water insoluble polyurea condensate has a molecular weight of < 800. The methylene bridged reaction product contains solid organic wastes and has linear, low molecular weight properties. An alkali is added to the solution for neutralization and the solid fraction is filtered from the solution.

C106
ADSORBENT FOR THE TREATMENT OF WASTE WATER,

Takegami, S., Korenaga, T., and Yoshinaga, C.

Japan Exlan Company Limited,
Osaka, Japan. (assignee)

United States Patent 4,081,403. Issued March 28, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 4, p 1468, March, 1978.

A granular adsorption medium containing activated sludge and a condensate of a formaldehyde resin or dialdehyde compound has been patented. The adsorbent is prepared with 100 dry weight parts activated sludge-treated organic wastes which are mixed with 5 weight parts of a water soluble condensate of either or both formaldehyde resin and dialdehyde compound. The dialdehyde compound is chosen from a group containing glyoxal, malonidialdehyde, succindialdehyde, and phthaldialdehyde. The 100:5 ratio mixture is cured by heating at 60-200 C and granulated. The medium is to be used for waste water treatment.

C107
ACTIVATED SLUDGE SYSTEM WITH STAGGERED PARTITION BASIN,

Block, C. S., Chen, M. S., Noichl, O. J., and Hong, S.

Air Products and Chemicals, Incorporated,
Allentown, Pennsylvania. (assignee)

United States Patent 4,081,368. Issued March 28, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 4, p 1456-1457, March, 1978.

An activated sludge tank with staggered partitions for moving mixed liquor through the aeration cycle in a serpentine manner has been patented. The staggered partitions project toward the center of the tank's width and extend the entire depth of the waste water. Mixed liquor is introduced into the tank through an inlet and is aerated as it passes in a cross-sectional flowpath. The open flowpath is maintained adjacent to the liquid passes in a range of 30-80% of the tank's wetted cross section. Complete mixing of the liquid passes is prevented to maintain an unequal oxygen demand through the effluent. Backflow is maintained between and within the liquid passes; the mixing factor of each aerator is within the range of 20-450.

C108
METHODS FOR USE IN WATER PURIFICATION PARTICULARLY SEWAGE TREATMENTS,

White, E. B., and Sharma, M. N.

Filters International Incorporated,
Chicago, Illinois. (assignee)

United States Patent 4,081,365. Issued March 28, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 4, p 1455, March, 1978. 1 fig.

A continuous, automatic waste water treatment process providing cyclical biochemical oxidation and flocculation-agglomeration of organic solids has been patented. Effluent containing more than 25 mg/liter BOD and suspended solids is introduced into an aeration chamber where the wastes are biochemically oxidized during periods of maximum sewage accumulation. During cycles of minimum sewage accumulation, following maximum accumulation periods, a preaerated flocculant is introduced into the chamber before the termination of biochemical oxidation to produce an instantaneous floc-agglomeration reaction in the sewage. The pH is maintained at a level suitable to the floc-agglomeration process; the zeta potential is stabilized at -5 to +5 ZP. Effluent is removed from the chamber during minimum accumulation periods and retreated with preaerated flocculant for further agglomeration of suspended solids which are then filtered from the effluent. Dissolved organic solids are removed from the filtered effluent by adsorption.

C109

CENTRIFUGE FOR DRAINING OFF SEWAGE SLUDGE,

United States Patent 4,085,887. Issued April 25, 1978. Official Gazette of the United States Patent Office, Vol. 969, No. 4, p 1344, April, 1978. 1 fig.

A centrifuge has been patented for removing sewage sludge and suspended solids from waste water. The centrifuge incorporates an inner rotary drum with a scraper mechanism; an outer rotary drum and scraper coaxially surround the inner drum. Sewage sludge is introduced through an inlet into the inner drum for preliminary separation. The outer drum for final separation has separate outlets for sewage sludge and liquid effluent at opposing ends. A passage in the inner drum, opposite from the waste water inlet, moves the waste water through the initial separating stage into the outer drum for final separation of the liquid fraction.

C110

BIOFILTER,

Tapola, E., Sten, M., and Koistinen, O.

Enso-Gutzeit Osakeyhtio,
Helsinki, Finland. (assignee)

United States Patent 4,086,167. Issued April 25, 1978. Official Gazette of the United States Patent Office, Vol. 969, No. 4, p 1433, April, 1978. 1 fig.

A biological filter design incorporating beds of porous media laid in a cup-shaped pit in the ground and a waste water spray distribution apparatus has been patented. The plastic fabric-lined pit is filled with a bottom layer of gas- and liquid-permeable gravel, followed by a bed of coniferous tree barking wastes extending above the top perimeter of the pit in a mound. The bark layer contains microorganisms and articles such as plastic, pine cones, tree limb sections, and tubular paper roll cores for maintaining the permeability of the filter bed and preventing compaction. The heap is covered with a roof equipped with a vertically mounted, rotating spray pipe for distribution of the waste water in a horizontal plane over the heap. The spray pipe contains a number of nozzles, each equipped with a deflector plate, and a feed tube supplying the waste water. Mounted within the gravel layer at the bottom of the pit is a radially extending pipe system which blows oxygen-bearing gas upward through the bark layer for aeration of the down flowing waste water. Below the aeration system, underdrains are embedded in the gravel for the collection and discharge of treated effluent. The roof is equipped with valves for exhausting the gas from the system.

C111

PURIFICATION OF WASTE WATER--CONTG. ORGANIC WASTE INCLUDES TREATMENT WITH MIXT. OF A SILICA GEL AND CELLULOSE,

Soviet Patent SU-290-694. Issued April 28, 1978. Derwent Soviet Inventions Illustrated, Vol. A, No. 7, p 2-3, 1978.

A patented process to reduce oxygen demand and pathogenic bacteria in waste water employs Cellogel paste, a mixture of silica gel and cellulose. The Cellogel is mixed with 20 ml of water and added to waste water containing organic wastes such as fatty acids, urea, and ammonia. About 58 g of Cellogel is added for each liter of waste water containing an oxygen demand of 2,175-4,360 mg/liter. After the paste is added, the effluent mixture is clarified and filtered. The final effluent has an average oxygen demand of 150-112 mg/liter; staphylococcus bacterial counts of 680,000 may be reduced by 100% after 45 min of contact with Cellogel. The Cellogel treatment process is especially suitable for closed cycle life support systems.

C112

CENTRIFUGE BASKET FOR SEWAGE TREATMENT SCREENS - HAS ALL-PLASTICS SEMI-CYLINDRICAL FRAME ELEMENTS WITH EMBEDDED SCREEN CLOTH AND GROOVE/TONGUE JOINTS AT FACE ENDS,

German Patent DS 2265-092. Issued April 13, 1978. Derwent German Patents Abstracts, Vol. A, No. 16, p 3, May, 1978.

A water-tight, plastic centrifuge basket to support waste water treatment filters has been patented. The plastic cage apparatus consists of a frame permanently connected to a filter grid which supports the embedded screen cloth filter medium. The frame is attached to the centrifuge unit. Plastic semi-cylindrical frame elements are mounted along the length of the cage; two or more elements are mounted in each filter cage. The elements are interconnected at both ends of the frame by tongue and groove joints that form sealed connections when in the locked position. The filter elements are disposable and prevent leakage when in use.

C113

BIOLOGICAL PURIFICN. PLANT FOR WASTE WATER AND SEWAGE--WITH CIRCULAR TANK DIVIDED INTO COMPARTMENTS BY VERTICAL WALLS,

French Patent FR 2354-973. Issued February 17, 1978. Derwent French Patents Abstracts, Vol. A, No. 13, p 4, May, 1978.

A patent has been issued a for circular biological waste water treatment tank which is divided into an oxidation chamber, a decantation zone, and a sludge thickening chamber. Half of the tank provides oxidation while the other half is divided into concentric zones for decantation and sludge thickening. A bridge, spanning the top of the circular tank, provides forward and backward movement about a central axis. The bridge supports a surface aeration turbine, a porticullis-type thickener equipped with a scraper, and a rake which extends to the bottom of one of the concentric areas. Debris is initially removed from the waste water by coarse screening; grease and oil are separated out. The effluent then flows by gravity to an oxidation chamber which contains activated sludge. The oxidation chamber is connected to the decantation zone by a perforated pipe. Effluent passes through this pipe into the decantation chamber for clarification. The treated waste water is discharged to another chamber and sludge is passed to the second concentric zone for thickening. Sludge is pumped from this zone by a unit mounted on the bridge. The system simplifies shuttering construction and reduces potential blockage by reducing the need for pipe systems.

C114

ACTIVATED SLUDGE TRANSPORT-IN COMPACT BIOLOGICAL EFFLUENT TREATMENT PLANTS,

German Patent DS 2232-477. Issued April 6, 1978. Derwent German Patents Abstracts, Vol. A, No. 15, p 2, May, 1978.

An activated sludge conveyance device has been designed for compact treatment plants to minimize interference with sludge settling during operation. Scrapers mounted within the secondary sedimentation tank convey the sludge toward a suction outlet. The suction device is connected to a pump carriage which moves back and forth above a secondary sedimentation tank located near the activated sludge tank. The partition between the activated sludge tank and secondary sedimentation tank supports and guides the movement of the pump carriage. The suction pipe transports the sludge into a stabilizing chamber located in the secondary sedimentation tank.

C115

TREATING BADLY POLLUTED WATER BY DISINFECTION AND FLOCCULATION - ESP. USING CHLORINE, WITH SEPN. OF SOLIDS OILS AND GREASE,

French Patent ZA 7701-432. Issued January 11, 1978. Derwent French Patents Abstracts, Vol. A, No. 12, p 2, May, 1978.

A disinfection and flocculation process for separating solids, oils, and grease has been patented for municipal, hospital, farm, and starch manufacturing waste water treatment. The solids in the waste water are initially reduced to fine particles, homogenized, and adjusted to pH 7. Air or oxygen is then injected while the wastes are agitated, followed by disinfection with active chlorine. The waste water is transferred to a reactor where it is neutralized with aluminum sulfate and flocculated with an optional additive. The water is separated from the solids fraction and may be reused or subjected to additional thermal disinfection; sludge is removed for composting. Coarser solids are reduced to a sludge and homogenized with agitation, followed by disinfection with Ca(OH)2 and flocculation. The liquid fraction is neutralized with AlCl3 or Al2(SO3)3 to promote flocculation.

C116
VACUUM SEWER SYSTEM,

Australian Patent 493,453. Issued June 15, 1978. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 48, No. 21, p 1925, June, 1978.

A patent has been issued for a sewage collection plant which operates with a vacuum. A vacuum is formed at the inlet to the sewage collection tank by a venturi ejector pump. A circulating pump operates the venturi ejector pump by circulating the collected waste water from the collection tank through the venturi pump. The waste water is partially treated as it circulates through the pump. As the contents of the collection tank are passed through the venturi ejector pump, the wastes are agitated, comminuted, and aerated.

C117
TREATMENT OF WASTE MATERIAL,

Australian Patent 493,562. Issued June 15, 1978. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 48, No. 21, p 1954, June, 1978.

Commonwealth Industrial Gases Ltd. has received a patent for a solid waste treatment process using cryogenic conditioning. Solid waste in sewage entering the treatment plant is separated from the inflowing waste water. The separated solids are first compressed and then cooled by exposure to a cryogenic liquid or a cold vapor generated from the liquid. The low temperature solid wastes become brittle and are comminuted.

C118
PROCESS FOR SEWAGE TREATMENT WITH COUNTERCURRENT HEAT TRANSFER MEANS,

United States Patent 4,094,773. Issued June 13, 1978. Official Gazette of the United States Patent Office, Vol. 971, No. 2, p 688-689, June, 1978. 1 fig.

A sewage digester which contains psychrophilic, mesophilic, and thermophilic zones and a sterilization stage with heat exchange has been patented. Sewage is introduced into a deep, narrow psychrophilic compartment and heated at 20-45 C. This is accomplished by mesophilic sludge flowing transversely into the compartment from an adjoining mesophilic zone. The upward conversion currents formed by the mesophilic layer of sludge form stratified layers of psychrophilic sludge and supernatant. The supernatant is then introduced into the deep, narrow mesophilic zone where it is further digested at 35-55 C by a thermophilic bacterial slime introduced from the adjacent thermophilic zone. The mesophilic supernatant flows into the thermophilic entrapment compartment where it is passed through a 50-100 micron filter. The filtered suspended solids are hydrolized at 45-70 C and digested by the bacterial slime. The treated effluent is heated as it flows to a sterilization compartment containing a heat transfer surface and heating elements. The effluent is heated to above 75 C and transferred to a storage compartment lying beneath the other compartments. Heat from the treated effluent is transferred sequentially to the sterilization, thermophilic, mesophilic, and psychrophilic compartments.

C119

METHOD AND APPARATUS FOR OXYGENATING AEROBICALLY DECOMPOSABLE LIQUORS,

United States Patent 4,094,774. Issued June 13, 1978. Official Gazette of the United States Patent Office, Vol. 971, No. 2, p 689, June, 1978. 1 fig.

A patent has been issued for an oxygenation system to treat aerobically degradable waste water and sewage effluent. An oxygenation tank, separated into a gas head section and a receiving section, is equipped with an inlet to maintain a constant volume of raw effluent or mixed liquor in the tank. The gas head section is connected to a supply of cooled, high purity oxygen by a conduit containing heating elements. The waste water or liquor is transferred under pressure to the gas head section where it is oxygenated. The oxygen-bearing effluent then passes to the receiving tank located below the gas head section. The liquor is then passed through a channel located near the oxygen supply conduit and over heat exchangers. Dissolved oxygen is removed from the liquor and transferred back to the gas head section in a gaseous state. The cooled effluent is then returned to the gas head section for reaeration.

C120

WATER-INSOLUBLE BIO-POLYMER FLOCCULATING AGENT SEPN. - FROM ACTIVATED SLUDGE USING ETHYLENE-DIAMINE TETRA:ACETATE, SODIUM CHLORIDE, ISOPROPANOL AND POLYVALENT METAL IONS,

Soviet Patent SU-563-423. Issued October 20, 1977. Derwent Soviet Inventions Illustrated, Vol. A, No. 21, p 5, July, 1978.

A method to prepare a water insoluble biopolymer flocculant from activated sludge has been patented. The activated sludge is initially centrifuged and extracted with a 2% disodium ethylenediaminetetraacetic acid solution for 4-5 hrs at 0-4 C. The extracted residue is centrifuged for 20 min at 0-4 C and treated with 2% NaCl in a volume of propanol or isopropanol equal to the sludge volume. The resulting biopolymer precipitate is redissolved in water and mixed with a magnesium or calcium ion-bearing aqueous solution. Polyvalent metal ions are added in the range of 0.05-0.125 mg/eq per mg of precipitate at 4-20 C to yield a 30% biopolymer flocculant. The flocculating agent can accelerate clarification rate by a factor of 2-8.

C121

EFFLUENT PURIFICATION - BY CONTROLLING MICROBIAL CONCENTRATION AND FLOW IN THE AERATION TANK,

French Patent FR 2362-794. Issued April 28, 1978. Derwent French Patents Abstracts, Vol. A, No. 21, p 4, July, 1978.

Aeration basin retention time may be reduced and nutrient removal improved when a 3-25 ratio of total organic carbon treated/day to microbial concentration based on weight is maintained in the aeration basin. The weight of the microbial concentration comprises 20-200 percent of the total organic content of the aeration tank effluent. This patented technique eliminates removal of activated sludge for recycle and prevents microbial inactivation under anaerobic conditions. The reduced microbial population of 50-400 ppm reduces the effluent residence time in the aeration tank to 1.5-6.0 hrs. The proliferation of active microorganisms improves nutrient removal; nitrogen is reduced by 70-90%, phosphorus by 50-70%, and BOD by 90-96%.

C122

SLUDGE DREDGER - FOR ELONGATED SETTLING TANKS ETC,

German Patent DS 2203-865. Issued May 24, 1978. Derwent German Patents Abstracts, Vol. A, No. 22, p 2, July, 1978.

A patent has been issued for a sludge scraping apparatus to be used with elongated clarifiers. A sludge scraper bridge is equipped with the scraper blade, a loading device, and a blade lifting unit. The scraper blade pivots up and down within the tank. The loading device is vertically mobile and is equipped with a connection rod assembly containing the blade lifter. The lifter, provided with a traction and pressure drive system, removes the blade from the clarifier. The loading device, which becomes operational after the sludge blade is lifted from the tank, has a release force that counteracts the load force. The release force is activated by a spring or weight assembly which supplies slightly less force than that of the loading system. The lifter size required for removing the scraper blade determines the size of the sludge scraping apparatus.

C123

CENTRIFUGAL LIQUID/SLUDGE SEPARATOR - WITH AXIALLY ACTUATED VALVE FOR SUPPLEMENTARY OUTLETS,

Soviet Patent SU-566-509. Issued August 19, 1977. Derwent Soviet Inventions Illustrated, Vol. A, No. 23, p 8, July, 1978. 1 fig.

A patent has been issued for a centrifugal waste water/sewage sludge separator which automatically evacuates accumulated sludge without interrupting operation. The centrifuge is equipped with a rotor containing a piston; located along the walls of the rotor and piston are channels which operate as jets and

C137

REMOVING ORGANIC MATERIAL, NITROGEN CPDS. AND PHOSPHATE(S) FROM WATER - BY COMBINED USE OF MICROORGANISMS AND POWDERED MINERAL,

French Patent FR 2364-859. Issued May 19, 1978. Derwent French Patents Abstracts, Vol. A, No. 24, p 3, July, 1978.

A patented process to remove organic compounds and nutrients from waste water with a powdered mineral and microorganisms requires fewer stages and smaller treatment equipment than conventional methods. From 1-200 g/liter of finely powdered calcite, hematite, or gibbsite with particle sizes of <0.297 mm is sustained as a microbial growth medium. The microorganism-bearing mineral is mixed with waste water in an oxidation zone where the dissolved oxygen concentration is maintained at 1-2 mg/liter. Biodegradable solids are oxidized to CO2 and nitrogen compounds are oxidized to nitrates and nitrites; the powdered metal ions simultaneously precipitate phosphorus from the effluent. The O2 concentration of the waste water is <1 mg/liter when it is transferred to the settling zone. Phosphate precipitation and denitrification continue in the settling area where the dissolved O2 concentration diminishes to <0.5 mg/liter. The biomass and solids are allowed to settle; effluent, bearing residual biomass, is then transferred to the clarifying zone where an O2 concentration of <1 mg/ml is maintained. Clarified effluent is decanted from the tank and the activated sludge is either returned to the initial oxidation tank or aerated and recycled to the clarifier.

C138

LIQUOR REMOVAL FROM LAGOON SURFACES - USING FLOATING TAKE OFF LINE WITH COMPENSATION FOR LEVEL CHANGES,

German Patent DS 2406-857. Issued June 29, 1978. Derwent German Patents Abstracts, Vol. A, No. 27, p 3, August, 1978.

A floating decantation apparatus which automatically adjusts to the liquid level in a waste water treatment lagoon has been patented. Floats mounted on an intake pipe maintain the liquid decantation orifice just below the surface of the liquid. The edge of the intake pipe lies behind a plane which is perpendicular to the influent source; this perpendicular plane also intersects the axis about which the intake orifice turns. As the level of liquid in the tank changes, the intake pipe inclines to compensate for the new level and maintains the inlet mouth below the surface as it turns. A constant volume of effluent is withdrawn from the lagoon by the apparatus, even in the presence of large liquid level fluctuations.

C139

APPARATUS FOR PURIFYING WASTE WATERS,

United States Patent 4,104,167. Issued August 1, 1978. Official Gazette of the United States Patent Office, Vol. 973, No. 1, p 278, August, 1978.

A patent has been issued for a waste water treatment apparatus containing equalization, aeration and sludge separation, and clarification zones. Waste water in the equalization zone is transferred into the top of a second tank which is divided into aeration and sludge separation zones by an inclined plate. Spaced apart from the tank floor and sides, the plate defines an upper, triangular aeration zone and the lower sludge settling area; an intake aeration channel is located in the lower corner of the tank and an outlet is positioned in the upper regions of the tank. Waste water bearing activated sludge is circulated up through the aeration channel and down through the aeration zone; the lower end of the slanted plate inhibits the circulation of the aerated water and increases the velocity along the bottom of the tank. A portion of the rapidly moving water enters the sludge separation zone where a fluidized bed of active media is formed. Effluent moving up through the fluidized bed is drawn into the clarification tank from the top of the sludge separation zone.

D001
APPLICATION OF OXYGEN TO TREAT WASTE FROM MILITARY FIELD INSTALLATIONS,

Malina, J. F., Jr.

Texas University,
Austin,
Department of Civil Engineering.

1973. 77 p, 9 fig, 14 tab, 45 ref, 1 append. NTIS Technical Report AD-A027-033.

Objectives of this program were to study the survival of enteric viruses and bacteria in stabilization ponds with high purity oxygen systems, and to examine the feasibility of using high purity oxygen in military installation field treatment facilities. The four laboratory-scale pond systems used in the study included a stabilization pond which was preceded by a mixed oxygenated lagoon, one which was preceded by an oxygen contact chamber, one in which oxygen was added to the first bay of the four-bay basin, and one to which oxygen was not introduced. Measurements of BOD, COD, total organic carbon (TOC), total oxygen demand (TOD), suspended solids, total coliform, fecal streptococcus, bacteriophage, and enteric animal viruses were used to evaluate pond performance. The system containing the oxygenated lagoon achieved the best results on the basis of virus and bacteria inactivation. Performance data for each of the systems is presented. At a loading rate of 250 lb BOD/acre per day, the simple stabilization pond was capable of removing 97.7% of BOD, 92.6% of COD, 84.2% of TOD, and 80% of TOC. Enteric virus and bacteria inactivation ranged from 88% to 94%, and bacteria reduction was in excess of 98%. When high purity oxygen was added, BOD, COD, TOD, and TOC removals were 98.6%, 94.6%, 89%, and 90%, respectively.

D002
UPGRADING EXISTING WASTEWATER TREATMENT PLANTS. PRE-PLANT CONSIDERATIONS,

Meenahan, J. G.

Johnson and Anderson, Incorporated,
Pontiac, Michigan.

1972. 11 p, 6 fig. NTIS Technical Report PB-258-811.

Because changing federal and state water quality standards may require waste water treatment plant operators to modify facilities to produce higher quality effluents, a discussion of pre-plant options in upgrading a facility is presented. Topics examined include: reasons for upgrading, collection systems, waste water flow measurement, definitions of waste water flows, flow equalization as a means of extending plant capacity, and necessary steps in the evaluation of existing facilities. Appendices to the report include an illustration of diurnal flow variation, population and flow projections, and process diagrams for an existing and a proposed plant.

D003
ALASKAN INDUSTRY EXPERIENCE IN ARCTIC SEWAGE TREATMENT,

Clark, S. E., Alter, A. J., Scribner, J. W.,
Coutts, H. J., and Christianson, C. D.

Environmental Protection Agency,
College, Alaska,
Alaska Water Laboratory.

1971. 32 p, 17 fig, 7 tab, 6 ref. Working Paper-13. NTIS Technical Report PB-257-585.

Limitations on water supply and waste disposal practices on Alaska's North Slope have prefaced this examination of two advanced physical-chemical treatment systems, extended aeration facilities, and other types of waste treatment facilities. Constructed to provide sewage treatment for Alaskan pipeline construction camps, the physical-chemical plants include alum flocculation, upflow clarification, first-stage downflow carbon adsorption-filtration, second stage upflow carbon adsorption, and chlorination. Provisions are made for separation and treatment of waste water according to origin (toilet versus other sources). Raw sewage characteristics are provided for five North Slope facilities, and effluent characteristics are provided for seven North Slope facilities. Average water usage and household sewage distribution tables are presented.

D004
CHEMICAL/BIOLOGICAL IMPLICATIONS OF USING CHLORINE AND OZONE FOR DISINFECTION,

Carlson, R. M., and Caple, R.

Minnesota University,
Duluth,
Department of Chemistry.

1977. 88 p, 7 fig, 17 tab, 151 ref, 2 append. Technical Report EPA-600/3-77-066.

Chemical and biological studies were conducted to determine the fate, distribution, speciation, and effects of chlorine, ozone and associated byproducts in waste water disinfection. The product distribution and individual components were examined for chlorinated or ozonated waste water containing the following: aromatics, alpha-terpineol, oleic acid, fatty acids, resin acids, cholesterol, and phenols. The toxicological effects of disinfection byproducts were examined for Daphnia magna. Hansch "structure-activity" relationships are suggested as useful in predicting phenol toxicities. The observed toxicity of phenols to Daphnia magna was attributed to the compound's lipophilic nature. A method for determining the partition coefficient with a "reverse-phase" high liquid chromatography column was devised to predict the effects of a compound on the environment. Laboratory studies were conducted to determine the effect of chlorination on the biochemical oxygen demand of effluents containing phenols, benzoic acid, and anilines. Lower BOD values and higher toxicities were associated with chlorination byproducts than with parent compounds.

D005

SEWAGE PLANT BUILT IN STAGES,

Journal of the Institution of Engineers (Australia), Vol. 49, No. 17, p 5, July, 1977.

A five-module sewage treatment plant planned for Townsville, Australia, is described. With an estimated cost of $14-17 million, the facility will be located several kilometers south of the Ross River. Preliminary designs, construction schedules, and estimates for the treatment plant have been accepted. The plant, scheduled for completion by 1985, will provide treatment for city sewage, 75% of which is currently discharged directly into Cleveland Bay through two outfalls. Sludge gas will be used to generate power for the plant. McIntyre and Associates, consulting engineers, have been commissioned for the project.

D006

REPORT ON EVALUATION OF WASTE SOURCES IN THE MEMPHIS, TENNESSEE AREA,

1975. 190 p, 20 fig, 25 tab, 3 append. Technical Report EPA-330/2-72-011.

The purposes of this study were to analyze waste water discharges from major industries in the Memphis, Tennessee, metropolitan area and to evaluate water quality of the Mississippi River upstream and downstream from the Nonconnah and Wolf interceptor sewers. Background information, waste sources and treatment, and a discussion of in-plant evaluations and results are presented. Average daily loads discharged by the 19 industries recognized as waste water sources are given. Effluents of one military installation and one municipal waste water treatment plant were also evaluated. Treatment recommendations for each source of pollution are given. Industries which now discharge or plan to discharge wastes to the Memphis sewer system and do not meet pretreatment requirements were identified.

D007
REPORT ON WATER QUALITY AND WASTE-SOURCE INVESTIGATIONS-MISSOURI RIVER AND PAPILLION CREEK, OMAHA, NEBRASKA,

1973. 242 p, 4 fig, 9 tab, 12 ref, 8 append. Technical Report EPA-330/2-73-001.

Studies of municipal and industrial waste water treatment facilities, as well as limited stream surveys of the Missouri River and Papillion Creek, were conducted in Omaha, Nebraska, to evaluate water pollution control practices, examine the adequacy of Omaha's sewer system, and evaluate pollution abatement progress. Surveys indicated that municipal and industrial waste water sources discharged daily loads of 135,000 lb BOD and 170,000 lb suspended solids. Removal of BOD and suspended solids by primary treatment at the Missouri River plant was 13% and 22%, respectively. Secondary treatment for all waste waters discharged to the Missouri River was recommended by 1975. An investigation of the sewage system indicated that raw waste water was often by-passed directly to the river. Replacement of the deteriorating combined sewers with separate storm and sanitary sewers was recommended. Principal municipal and industrial waste sources are described. Aspects of the sewerage system which are discussed include diversion structures, grit removal facilities, and lift stations. Results of stream surveys, recommended standards for effluent quality, and the status of water pollution abatement measures in the area are discussed.

D008
HIGH PURITY WATER TREATMENT PERFORMS WELL AT EUROPE'S FIRST PLANT,

Materials Handling News, No. 236, p 3, July, 1977.

A high purity oxygenation system, the Union Carbide Wimpey UNOX Pressure Swing Adsorption Unit, has been installed at a waste water treatment plant in Palmersford, England. The system is being used to treat sewage and organic industrial sludges for a population of up to 24,000 while taking up only half the space of a conventional filtration plant. Pure oxygen is fed to the system at the first stage. Compressed, cooled, dewatered air is passed to molecular sieves. BOD is reduced to 20 ppm in the first stage and to a final concentration of 10 ppm after ammonia is removed in the second stage. Constant pressure monitoring and a standby liquid oxygen supply are provided for the aeration tanks. The 90% oxygen supplied to the tank results in higher treatment efficiency and shorter required retention times. The UNOX system is suggested for use in any facility in which organic wastes are treated.

D009
CENTRAL KITSAP COUNTY WASTEWATER FACILITIES,

1976. 466 p, 22 fig, 37 tab, 72 ref, 10 append. Technical Report EPA-910/9-75-012.

The final environmental impact statement for a proposed $18 million project to construct interceptor sewer lines, a waste water treatment facility, and a waste water disposal facility in Kitsap County, Washington, is presented. Eleven alternatives developed for the facilities plan are described. Detailed descriptions of the environmental setting and of the environmental impacts of the proposed project are given. Adverse impacts and mitigative measures are described. Design flows and other data are presented for the project. Major recommendations for the project include: revegetation and tunnelling to prevent erosion of shoreline bluffs at outfall sites; porous backfilling for the sewerage system; and a comprehensive metering study for outfall diffuser design.

D010
SAFER, CLEANER HANDLING OF SEWAGE PUMPS,

Surveyor, Vol. 150, No. 4443, p 23, August, 1977.

Missing Links, a series of submersible sewage pump transport units, are being produced by Treatment Contracts Limited of Andover, England. The Missing Link is capable of lifting and transporting pumps by means of a trailer-mounted framework which can extend the slide rail system above ground. The pump can be drawn up into a cage for cleaning and servicing. A service unit for ladder racks, inspection lamps, tools, and replacement pumps is also available. Two models of the pump handling systems are marketed for pumps of 2-5 hp and for pumps in the 7.5-30 hp range.

D011
SEWAGE WORKS FOR TEL AVIV,

Water and Waste Treatment, Vol. 20, No. 7, p 11, July, 1977.

An IL 1,042 million sewage treatment plant has been planned for the greater Tel Aviv area in Israel as an alternative to the current practice of ocean dumping. Cooperative settlements in the southern desert area will use the effluent produced by the proposed facility, located at Rishon le Zion, for agricultural purposes. Mechanical aeration will be used at the facility to provide an effluent which will be applied to non-food crops. The facility will serve a population of 1 million, and will treat 100 million cu m of water per year, or about 10% of Israel's annual water consumption.

D012
THE RECLAMATION OF DRINKING WATER FROM SEWAGE,

McGarry, M. G.

Asian Institute of Technology,
Bangkok, Thailand.

1975. 75 p, 20 ref, 16 fig, 5 tab. NTIS Technical Report FE-472-2.

Various aspects related to the direct reclamation of waste water for drinking are discussed. Practices in Thailand which involve the photosynthetic recovery and harvest of nitrogen in the form of algal protein and the removal of low level organics by burnt rice husk media filtration are described. Varieties of roughing filtration are examined. Pilot studies on photosynthetic stripping of nitrogen from clarified high rate pond effluent are described. Experiments dealing with powdered activated carbon adsorption were conducted to examine starting material, chemical treatment methods, and particle size. Dual media and semi-rapid filtration are discussed for application to local filter media materials in Thailand. Results of experiments on organic and ammonia nitrogen removal by breakpoint chlorination are given. Design configurations to integrate unit processes into continuous flow systems for renovation of domestic waste water are evaluated.

D013
A TURN FOR THE BETTER,

Electrical Review, Vol. 201, No. 5, p 31, July, 1977.

Automatic operation of eight penstocks which control the flow of sewage to aeration tanks at the Beckton waste water treatment plant in North London, England, has been supplied by the Retrofit Division of Rotork Controls Limited. Commissioned by the Thames Water Authority, motorization of the penstocks has reduced from 40 to 6 minutes the time required for closing from a fully open position. The more rapid response has produced a better flow balance through the tanks, as well as easier cleaning and maintenance. Push-button control is currently being used for startup, but provisions for future remote control of the system are being made. The Beckton sewage treatment plant is capable of handling a dry weather flow of 250 mgd and a wet weather flow of up to 600 mgd.

D014
SELF-CLEANING FILTER/SCREEN,

Water and Waste Treatment, Vol. 20, No. 7, p 46-47, July, 1977.

A continuous, self-cleaning filter screen, the Japanese-designed Aqua-Guard, is described. A filter element-rake combination is used to remove suspended

D027
CARBON-CHLORINE-CARBON SEWAGE TREATMENT,

Green, R. H., Howland, R. G., and Wallace, C. J.

Caltech/JPL,
Pasadena, California.

NASA Tech Briefs, Vol. 2, No. 2, p 200, Summer, 1977. 1 fig.

Potential hazards posed by toxic and carcinogenic compounds produced by the reaction of chlorine with organics and other chemicals present in waste water treated by chlorination have led to the reevaluation of the use of chlorine as a disinfectant. An activated carbon treatment system was developed by Caltech/JPE and NASA with the cooperation of Orange County, California, to reduce potentially hazardous chlorinated substances in a combination carbon-chlorine-carbon treatment scheme. Activated carbon is generated at the treatment site through processing of sewage solids. Carbon is added to the primary sedimentation basin before chlorination and to the secondary clarifier after chlorination. The initial contact with carbon reduces the concentration of potentially hazardous substances which might react with chlorine, and the second carbon contact removes residual chlorine and chlorinated substances. Laboratory experiments were used to examine the ability of the proposed treatment scheme to remove phenols, aliphatic amines, aromatic amines, and polychlorinated biphenyls. Studies with final effluent from the waste water treatment plant in Orange County were used to verify the results.

D028
THE TREATABILITY OF LEACHATES FROM SANITARY LANDFILLS,

Buchanan, R. J., Jr.

Dissertation Abstracts International B, Vol. 38, No. 4, p 1631-1632,
October, 1977.

Physicochemical and biological treatment processes applicable to leachates from sanitary landfills were investigated in bench-scale and full-scale experiments. Laboratory experiments examined the effects of precipitants, coagulants, activated carbon, low pH biological treatment, and conventional activated sludge processes on landfill leachates. Treatment with the ferrous oxidizing bacterium, Thiobacillus ferrooxidans, in the low pH treatment scheme was demonstrated as feasible for leachates.

D029
DESIGNING MORE ENERGY-EFFICIENT WASTEWATER TREATMENT PLANTS,

Banerji, S. K., and O'Conner, J. T.

Missouri University, Columbia,
Department of Civil Engineering.

Civil Engineering-ASCE, Vol. 47, No. 7, p. 76-81, September, 1977. 4 fig, 6 tab, 19 ref.

Rising energy costs have made designs for energy-efficient waste water treatment systems attractive to plant operators and design engineers. Energy costs and typical energy requirements for waste water treatment processes are described. Power requirements are compared for secondary waste water treatment processes, including conventional activated sludge, rotating biological contactor, activated bio-filtration, and high rate trickling filtration. Energy consumption for tertiary and advanced waste water treatment processes is described. Energy requirements of land treatment of waste water with irrigation, infiltration/percolation, or overland flow are compared with those of advanced waste water treatment. Gravity thickening and anaerobic digestion, which use less energy than flotation thickening and aerobic digestion, are suggested as means of sludge treatment. Performance data for various modes of sludge dewatering are compared. Refuse-derived fuel is discussed as an alternate fuel for sludge incineration. Waste water pump type and operating parameters are discussed with respect to power requirements.

D030
NITRIFICATION IN OXYGEN ACTIVATED SLUDGE SYSTEMS,

Gyger, R. F., and Braunscheidel, D. E.

Union Carbide Corporation, Linde Division,
Tonawanda, New York.

AIChE Symposium Series, Vol. 73, No. 167, p 243-249, 1977. 5 fig, 2 tab, 29 ref.

A model for the design of oxygen activated sludge systems for nitrification is presented. The Monod model which was used to describe ammonia substrate removal and growth of nitrifying bacteria is based on the relationship between growth and endogenous decay of the organisms. Required parameter determinations include the yield and endogenous decay coefficients, the saturation constant, and system oxygen requirements. Previous studies on the effects of environmental factors such as temperature, dissolved oxygen concentration, pH, available substrate, and toxic compounds on biological treatment processes are described. Pilot plant studies on one- and two-step carbonaceous removal and nitrification systems such as the Union Carbide-manufactured UNOX system are described. The validity of the nitrification model was tested by comparisons of the theoretical amount of SRT required to achieve the observed ammonia concentration under a certain set of environmental conditions with the actual SRT observed in the operation of various nitrification systems. The analyses indicated that the Monod model was acceptable for the design of nitrification systems and that large increases in the SRT above the minimum critical SRT values necessary for nitrification did not significantly improve system performance. Design considerations for the one- and two-step systems are discussed with respect to sludge retention time, oxygenation tank volume, and the food:microorganism ratio.

D031

REVIEW PAPER: POTENTIAL FOR PARASITIC DISEASE TRANSMISSION WITH LAND APPLICATION OF SEWAGE PLANT EFFLUENTS AND SLUDGES,

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Pittsburgh University, Pennsylvania,
Department of Life Sciences.

Water Research, Vol. 11, No. 7, p 583-595, 1977. 1 tab, 114 ref.

Historical background information and a literature review are presented for waste disposal of sewage treatment plant products by land application. Advantages and disadvantages of land application are discussed, including: possible environmental and health hazards, groundwater recharge, protection of surface waters, disease transmission, and soil conditioning. Previous studies on the fate and distribution of toxic substances and pathological organisms are cited. Literature is reviewed on the fate of parasitic forms during various phases of sewage treatment, including sedimentation, flocculation, secondary treatment, anaerobic digestion, drying and survival in soil, composting or aerobic digestion, temperature and survival in the soil, and chemicals and other types of disinfection. Information and evidence on disease transmission related to land application of sewage plant products are presented. Investigations on the fate of parasitic cysts and eggs in conventional sewage treatment processes are discussed. A summary of infective parasites likely to be found in sludge is presented. Since land application of sludge may be an efficient method of soil enrichment as well as a method of waste disposal, technology and management control to reduce or eliminate parasitic disease transmission is stressed.

D032

NEW 'PHILADELPHIA STORY' BEING WRITTEN BY POLLUTION CONTROL DIVISION,

Nelson, M. D., and Guarino, C. F.

Water Pollution Control Division,
Philadelphia, Pennsylvania.

Water and Wastes Engineering, Vol. 14, No. 9, p 22-26, 28, 38, September, 1977. 4 fig, 1 tab.

Additions in 1977 to the Southwest Water Pollution Control Plant, one of three which service Philadelphia, Pennsylvania, are described. The plant had been providing primary treatment for a waste water flow of 136 mgd with bar screens, grit channels, flocculation tanks, primary sedimentation tanks, and separate sludge treatment facilities. The expanded facility will provide treatment for an average flow of 210 mgd with provisions for expansion to 285 mgd. Additions to the plant include expanded and remodeled primary treatment facilities, oxygen activated sludge process facilities, and separate sludge treatment facilities to provide screening, grit removal, settling, biological treatment, and disinfection before treated effluent is discharged to the Delaware River. SURFACT, a rotating biological contactor which is submerged in a diffused air aeration tank, is being examined as a means of improving operating efficiency. Advantages of the fixed film contactor include process flexibility, lower susceptibility to upset, potential for both carbonaceous and nitrogenous removals in the same tank, the ability to use energy derived from the activated sludge system, and low capital and operating costs. Design criteria and costs for the prototype, a 20-mgd pilot-scale SURFACT system in operation at Philadelphia's Northeast treatment plant, are presented.

D033

PUTTING POWDERED CARBON IN WASTEWATER TREATMENT,

Environmental Science and Technology, Vol. 11, No. 9, p 854-855, September, 1977. 1 fig, 1 tab.

A carbon/wet oxidation system, produced by Zimpro Inc. of Rothschild, Wisconsin, is described. Treatment with the Zimpro system includes adsorption on powdered activated carbon, conventional biological treatment, and regeneration of the spent carbon by wet air oxidation. The system is being used to upgrade the Liverpool Sewage Treatment Plant in Medina County, Ohio, from a conventional activated sludge facility to a 10-mgd advanced waste water treatment facility. The treatment is suggested as highly effective for industrial wastes or combined municipal-industrial wastes. Results of pilot studies to compare performance of the carbon/wet oxidation system with the conventional two-stage activated sludge system and to determine system nitrification, denitrification, oxygen transfer, and sludge characteristics are presented. Advantages of the system include: simultaneous adsorption of biodegradable and non-biodegradable wastes, high levels of nitrification due to long sludge age, and simultaneous destruction of biological solids and regeneration of spent carbon during wet air oxidation. Municipal and industrial waste treatment facilities currently using the Zimpro system of carbon/wet oxidation are listed.

D034

GRAIN SIZE DISTRIBUTION WITH DEPTH IN MULTILAYER GRANULAR BED WATER FILTERS,

Lekkas, T. D., and Fox, G. T. J.

Imperial College, London, England,
Department of Public Health Engineering.

Filtration and Separation, Vol. 14, No. 5, p 461-462, 464, 466, 470, September-October, 1977. 10 fig, 11 tab, 6 ref.

Stratification during backwashing of granular filter beds reduces filter efficiency by producing beds with a smaller grain size at the top and a larger grain size at the bottom of the filter. The use of upflow filters and the use of larger but lighter grains have partially alleviated the problem of stratification. Pilot studies using a two-layer filter (anthracite and sand) and a three-layer filter (polystyrene, anthracite, and sand) were conducted to determine the distribution in grain size with depth. Stratification was not significant for sand, but was significant for anthracite in the two-layer filter and for polystyrene and anthracite in the three-layer filter. For the anthracite layer the grain size distribution is mathematically derived as a function of depth. Grain sphericity was measured according to mean sieve size, and according to count and weight equivalent grain size, to determine if shape stratification occurred within the anthracite layer in the two-layer filter. The studies indicated that some stratification did occur since sphericity increased with depth. Increasing the number of layers in a multilayer filter reduced the effects of size stratification on filter performance.

D035

SEWAGE SLUDGE ANSWERS ARE STILL NEEDED,

Farm Chemicals, Vol. 140, No. 6, p 40, 42, June, 1977.

Various aspects related to the environmental effects of the application of sewage sludge to cropland are discussed. Although only 1% of the total 1970 cropland would be required for disposal of all of the sludge produced annually in the United States, one of the problems associated with land application as a means of sludge disposal is that the highest quantities of sludge are produced in highly populated areas where the amount of land available for agricultural purposes is limited. Studies on the long-term environmental impact of sludge application have indicated that the uptake of metals in sludges by plants is greater during the initial application than during subsequent periods. Criteria for the feasibility of land application programs are based on the nitrogen, phosphorus, and heavy metal contents of the sludges. Various studies on the uptake by plants and adverse effects of heavy metals are discussed. Elements which are considered to pose relatively little hazard to crop production include Mn, Fe, Al, Cr, As, Se, Sb, Pb, and Hg. Elements which are discussed as posing hazards under certain conditions include Cd, Cu, Mo, Ni, and Zn.

D036

COMPOST LATRINES IN TANZANIA: A PRELIMINARY REPORT,

Gurak, R., Kilama, W., and Winblad, U.

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Department of Parasitology and Entomology.

Compost Science, Vol. 18, No. 4, p 20-23, July-August, 1977. 3 fig, 17 ref.

Diseases and parasites associated with the disposal of human wastes in Tanzania include enteric fevers such as typhoid and paratyphoid, bacillary dysentery, poliomyelitis, cholera, intestinal parasites, hookworm, ascaris lumbricoides, intestinal schistosomiasis, urinary schistosomiasis, and amoebiasis. A program for research and development of latrines for villages and low-income residential areas was initiated in 1975 to outline performance criteria for domestic waste disposal systems, to examine shortcomings of existing waste disposal systems, and to evaluate and recommend various methods of domestic waste treatment. General performance criteria were based on ecological, health, nuisance, operational, and cost considerations. Categories of compost latrine systems which were examined include discontinuous, alternating, continuous, and compact with heating systems. Results of a pilot program with the construction of latrines in three villages in eastern Tanzania and in one squatter area on the outskirts of Dar es Salaam are presented. Problems associated with use of the latrines were related to the addition of excess liquid to the essentially dry systems.

D037

COMPOSTING INDUSTRIAL AND MUNICIPAL WASTES PAPER MILL AND CITY TREATMENT PLANT,

Weir, D. R., Jr.

"208" Water Quality Planning Program,
Montachusett Regional Planning Commission,
Fitchburg, Massachusetts.

Compost Science, Vol. 18, No. 4, p 27, July-August, 1977. 1 tab, 1 ref.

Environmental Research and Technology and the Montachusett Regional Planning Commission were called upon to develop a proposal for the production of compost from a combination of paper mill and municipal waste water treatment sludges. The project was initiated as an energy and cost conservation measure and for compliance with objectives set out in the 1972 amendments to the Federal Water Pollution Control Act. Existing advanced waste water treatment plants in Fitchburg, Massachusetts, included an activated carbon absorption plant for the paper industry and a two-stage activated sludge and chemical precipitation plant for municipal wastes. Analyses of the sludges indicated that except for high cadmium levels, the 3 ton/day of sludge produced by the activated sludge plant and the 10 ton/day produced by the activated carbon plant would be safe for use as a fertilizer and humus soil conditioner. Previous annual expenses for sludge disposal included $50,000 in fuel costs for incineration of the municipal sludge and $25,000 for landfilling of the paper mill sludge. The proposed composting operation is expected to cost $20,000/yr or about $20/ton with a land requirement of about 3 acres for the full-scale operation. The project is also expected to eliminate possible nonpoint water pollution from landfilling and air pollution from incineration.

D038

MAKE PURE WATER OUT OF WASTE,

The American City and County, Vol. 92, No. 9, p 50, September, 1977.

PureCycle, a computer-controlled module to recycle household waste water, is described. The system does not require water and sewer hookups and is composed of two 440-gal tanks and the processing system. The average treatment capacity of the system is 440 gpd with peak loading capacities of 800-1000 gpd. The processing system includes a biological reactor which uses disc rotation and a combination of aerobic and anaerobic digestion to oxidize organics. A pressurized filtration stage removes bacteria, viruses, and suspended particulates. Color, odors, and organic contaminants are removed by a carbon adsorption bed. Demineralization removes heavy metals and inorganic salts. Ultraviolet radiation is used to sterilize the recycled water. Processing is continuously monitored by a microcomputer. PureCycle of Boulder, Colorado, provides a service center to periodically remove solid organics and provide the initial 500 gal of water to start up the system. At current costs the break-even point is 200 PureCycle units per service center. Use of the system is suggested for areas with limited natural water supplies.

D039

REMOVAL OF ESCHERICHIA COLI IN WASTEWATER BY ACTIVATED SLUDGE,

Van Der Drift, C., Van Seggelen, E., Stumm, C., Hol, W., and Tuinte, J.

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Department of Microbiology.

Applied and Environmental Microbiology, Vol. 34, No. 3, p 315-319, September, 1977. 3 fig, 10 ref.

A streptomycin-resistant strain of Escherichia coli was used in laboratory studies on the removal mechanisms of bacteria from waste water treated with activated sludge obtained at a municipal waste water treatment plant in Valburg, The Netherlands. The removal of E. coli by activated sludge is reported as a two-phase process with initial rapid removal and subsequent slower removal. The rapid decrease during the first hour after the addition of E. coli cells to mixed liquor was observed as following a Langmuir adsorption isotherm. Although the number of free E. coli decreased rapidly in the first hour, the total number of E. coli decreased at a much slower rate. Subsequent slower removal of E. coli was attributed to predation by ciliated protozoa as evidenced by the presence of fluorescent food vacuoles of ciliates when fluorescent E. coli cells were added to mixed liquor, by the inhibition of predation in the presence of cycloheximide or under anaerobic conditions, and by the absence of predation in bulking and washed sludge.

D040

SLUDGE EXTRACTION WITH PNEUMATIC ASSISTANCE,

Water Services, Vol. 81, No. 978, p 506, 509, August, 1977.

The Sewpas unit was designed as a mechanical aid for sludge withdrawal from a hydrostatic valve with an operating range of approximately 1 m hydraulic differential head. The Sewpas unit was tested over a 12-month period at the Upper Stour Main Drainage Board works in England and reduced the sludge volume by 20% over the volume achieved with manual control of desludging operations. Installation requirements include the connection of an air pipe to the existing sludge pipe via a flange adaptor, and the installation of a vertical upstand pipe to contain discharge from the airlift. The Sewpas system is designed to handle sludges with solids concentrations of 8-10%. Unlike a conventional air lift system which alters the specific gravity of the sludge, the Sewpas unit utilizes a large air bubble as a piston to eject the sludge. Semi-automatic process control is provided to regulate the on-off periods of the unit. The use of ultrasonics to measure sludge solids concentrations is discussed as a future method of controlling the cut-off of the air pump.

D053
STUDY ON SLUDGE TREATMENT--2ND REPORT,

Kawahara, H., Tsuchida, M., Koido, Y., Endo, I., and Sago, M.

1973. 67 p, 17 fig, 9 tab, 3 ref. Technical Report EPA-TR74-38D.

An English translation of the Japanese Annual Report of the Tokyo Metropolitan Research Institute for Environmental Protection, March, 1973, is presented. A method of sludge treatment and disposal which involves combining sewage sludge with cement for solidification is described. Results of investigations on the relationship between sludge-cement strength and the amount of organic substances in the sludge are presented. Various proportions of digested sludge and Portland cement were mixed and then hardened in molds. Results indicated that the effects of the amount of organic substances were much greater at low cement:sludge ratios. Relationships between composite strength, sludge organic content, composite water content, and cement:sludge ratio are illustrated. The leaching of heavy metals from solidified sludge composites was also examined. The studies indicated that heavy metals were leached and exuded from sludge ash and cement blocks which contained sludge ash, but were not appreciably leached or exuded from conventional sewage sludge or sewage sludge-containing blocks. This was attributed to the fact that sludge ash generally contains higher concentrations of heavy metals than other sludge types. The recommended quantity of cement to produce sludge solidification was 5-7.5 kg cement/kg dried sludge.

D054
SEWAGE PLANT BENEFITS FROM ADJUSTABLE FREQUENCY DRIVES,

Control Engineering, Vol. 24, No. 12, p 22, December, 1977.

A Georgia sewage treatment plant has installed adjustable speed raw sewage pumps. General Electric's Speed Variator Products in Erie, Pennsylvania, produces the inverter drives used in the 10 mgd system. Incoming power is converted from AC to DC with a silicon diode rectifier and then inverted to adjustable AC voltage and frequency. This is accomplished by an SCR invertor with pulsewide modulation. The invertors provide four operable modes: two automatic and two manual. The lead pump operates at speeds adjusted according to flow measurements by the automatic bubbler sensor system. The lead pump operates at a constant speed controlled by the power bus when the lead pump is inadequate for the rate of flow. The lag pump starts automatically and maintains a desirable influent level with adjustible speed. Increased flow at this point causes the lag pump, controlled by the power bus, to increase to constant speed. When flow decreases, each pump reverts in sequential order to original drive. The system shuts down sequentially when a power failure occurs and starts in a prescribed order when power returns. The system was designed by Robert and Co Associates of Atlanta, Georgia.

D055
OXYGEN TRANSFER TESTS PROVE EFFICIENCY OF FINE BUBBLE DIFFUSER,

Bacon, V. W., Balmer, R. T., and Griskey, R. G.

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Department of Civil Engineering.

Water and Sewage Works, Vol. 124, No. 9, p 121-124, September, 1977. 10 fig, 1 tab, 18 ref.

A 31,000-gal test facility in Glendale, Wisconsin, was used to evaluate the Air-Aqua fine bubble diffuser system manufactured by Hinde Engineering Company. Design data for the oxygenation tank, which contained seven lengths of Air-Aqua tubing and 11 samplers, are presented. Data were collected on dissolved oxygen saturation of the tank with coarse bubble diffusers and deoxygenation. An equation to represent mass transfer in a gas-liquid contacting process is presented. The overall oxygen mass transfer coefficient is related to the oxygen deficit, temperature, and depth. Data collected at the Glendale facility indicate that the overall oxygen mass transfer coefficient increases with decreasing depth at constant aeration rates and with increasing aeration at constant depth. The effects were attributed to increased aeration which resulted in greater mixing and gas throughput, and greater mixing at lower depths caused by a concentration gradient. A quotient for the amount of oxygen transferred to the test water at standard conditions is derived. The efficiency of the aeration system is calculated on the basis of the transfer coefficient and the amount of oxygen added to the system. Efficiencies at the test site ranged from 16.2% to 25%. Oxygen transfer efficiency is related to blower horsepower. The effects of depths, air flow rate, and aeration time on the oxygen deficit, oxygen transfer rate, and oxygenation efficiency are illustrated. Tests at the Glendale facility suggested that the Air-Aqua system was competitive in terms of efficiency and oxygen transfer rates.

D056
ENERGY USES AND RECOVERY IN SLUDGE DISPOSAL, PART 3,

Jones, J. L., Bomberger, D. C., Jr., and Lewis, F. M.

Water and Sewage Works, Vol. 124, No. 9, p 106-108, September, 1977. 3 fig, 2 tab, 3 ref.

Sludge disposal and treatment options, relative energy requirements, and process cost sensitivities to recovered energy value are discussed with regard to municipal waste water treatment. Land application costs are controlled by land costs, application rates, and the quantity of sludge produced. Sludge handling costs for incinerating a 40% solids cake produced by chemical conditioning and dewatering by filter press are compared to the total operating costs for 10-, 100- and 500-mgd plants. Specific components of the direct operating cost for sludge disposal are represented as a percentage of total plant operating cost, including electric power, fuel, chemicals, and hauling and disposal. The control of air pollution resulting from sludge incineration is discussed. Relative flue gas volumes are compared for multiple hearth and fluidized bed incinerators, and are used to calculate electric power requirements for scrubber operations on the basis of feed solids, excess air, sludge solids content, and exhaust gas temperature.

D057

CONVERSION OF SLUDGES INTO "TOPSOILS" BY EARTHWORMS,

Mitchell, M. J., Mulligan, R. M., Hartenstein, R., and Neuhauser, E. F.

New York State University, Syracuse,
College of Environmental Science and Forestry.

Compost Science, Vol. 18, No. 4, p 28-32, July/August, 1977. 2 fig, 4 tab, 9 ref.

Laboratory studies were used to evaluate the potential role of two varieties of earthworms, the redworm Eisenia foetida and the nightcrawler Lumbricus terrestris, in the conversion of odorous, chemically unstable sludges into rich organic soils. Chemical characteristics of the anaerobically and aerobically digested secondary sludges used in the study are presented. The sludges, obtained from four waste water treatment plants in Onondaga County, New York, contained appreciably larger amounts of organic matter and nitrogenous compounds than those in mineral soils. The anaerobic sludges collected at the Metropolitan and Morgan Road plants were extremely toxic to the earthworms and sowbugs, and the Ley Creek anaerobic sludge was moderately toxic. Aerobic sludges were avidly consumed and did not cause earthworm mortality. The rate at which sludge passes through the gut of redworms was examined as a function of sludge type, moisture, and temperature. Data on the bioacceleration of sludge decomposition in earthworm and terrestrial isopod excreta are presented. Changes in humic acid content of sludges as a function of worm activity were examined. Studies on the rate of total combustion of organic matter in sludges indicated that the ash content of the Meadowbrook sludge increases from 2.15% to 3.52% over a 4-wk period in the presence of nightcrawlers and redworms at concentrations of 24.1 and 14.5 g worm/100 g sludge, respectively.

D058

ECONOMICS OF TRANSPORTING WASTEWATER SLUDGE,

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United States Environmental Protection Agency,
Denver, Colorado.

Public Works, Vol. 108, No. 9, p 110-111, September, 1977. 2 fig, 1 tab.

Land application of treated domestic sludge as a means of soil conditioning and waste disposal has prefaced this article on the economics of transporting waste water. Costs incurred in sewage sludge utilization systems at 15 sites in various parts of the United States are discussed. Cost factors for separate sectors of the process were used to develop a "model" community for use in estimating costs and determining economic feasibility of land application. The model community is based on a system that treats an average flow of 10 mgd and produces 800 tons/yr of stabilized sludge as dry solids. Annual costs for land application in such a system are estimated at $27,400 or $35/ton. The total annual operating cost is divided according to labor, fringe benefits, vehicle operation and maintenance, and miscellaneous expenses. The total annual cost of land disposal of sludge is also plotted against average daily raw waste water flow from a linear regression of data obtained during the survey.

D059

SIGNIFICANCE OF DIURNAL VARIATIONS IN FECAL COLIFORM DIE-OFF RATES IN THE DESIGN OF OCEAN OUTFALLS,

Bellair, J. T., Parr-Smith, G. A., and Wallis, I. G.

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Melbourne, Australia.

Journal Water Pollution Control Federation, Vol. 49, No. 9, p 2022-2030, September, 1977. 5 fig, 3 tab, 10 ref.

The rate of die-off of fecal coliform bacteria was investigated as part of the design study for three deepwater ocean outfalls near Sydney, Australia. Plastic bags at the water surface and clear glass bottles suspended at various depths were used to examine the effects of initial dilution, ambient water conditions, and light attenuation on die-off rates. T-90 values for both types of sample containers were similar during hours of darkness. Largest die-off rates during hours of greatest light intensity were attributed to the effects of solar radiation. T-90 values exhibited strong diurnal variations ranging from a maximum of 40 hrs during the night to a minimum of 1.9 hrs just before noon. A strong inverse relationship between T-90 values and depth was attributed to decreasing solar radiation with depth by light attenuation. The diurnal variation in T-90 values was also reflected in fecal coliform densities on beaches adjacent to ocean outfalls. Equations representing the resultant fecal coliform density in bathing waters, the initial dilution, a diffusion factor, and a die-off factor are presented. Implications of the diurnal variation and rate of coliform die-off for ocean outfalls are discussed. The location of outfalls in areas of high turbulence to create high initial dilutions is suggested, since fecal coliform densities may not be sufficiently reduced by other factors during the night.

D060

INSTALLATION, OPERATION AND MAINTENANCE OF VERTICAL TURBINE PUMPS,

Hodgins, B.

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Barrie, Ontario, Canada.

Water and Pollution Control, Vol. 115, No. 8, p 19-20, August, 1977.

The functions of the basic parts of a vertical turbine pump, including driver, pump head, discharge column, and bowl assembly, are described. Operation and maintenance are considered for various pump types (one-stage, two-stage, submersible, and turbine). Water and/or oil lubrication of the line shaft is described. Care and maintenance of a vertical turbine pump is considered to prolong pump life. Proper installation is discussed as the first step in care and maintenance. Pump performance should be checked with the factory performance curve. Other aspects of pump monitoring include measurement of discharge pressure and flow and recording of startup time. Routine observations useful in reconstructing a pump performance curve are described. Various causes of pump failure are discussed, including corrosion, abrasion, erosion, cavitation, graphitization, and impingement.

D061

INVENTORY OF ENERGY USE IN WASTEWATER SLUDGE TREATMENT AND DISPOSAL,

Smith, J. E.

Industrial Water Engineering, Vol. 14, No. 4, p 20-26, July/August, 1977. 12 fig, 10 tab.

Costs for sludge treatment and disposal are dependent on a wide variety of factors, including method, location, climate, scale of operation, and effluent quality desired. Fuel use and energy requirements for various types of municipal waste water treatment and disposal are discussed. The distributions of capital, operating, and maintenance costs for a 30-mgd conventional activated sludge plant are presented. Costs for sludge handling processes, including thickening, stabilization, conditioning, dewatering, and incineration, are discussed and related to plant size. Electrical energy requirements for various phases of sewage treatment, including preliminary treatment, influent pumping, primary sedimentation, trickling filters, activated sludge processing, chlorination, sludge handling and disposal, and miscellaneous operating needs, are described and compared for different plant sizes. The utilization of anaerobic digester gas for power generation is examined. Sludge dewatering and disposal options are examined relative to construction costs, energy consumption and production, and sludge water content.

D062
CARBON AND NITROGEN TRANSFORMATIONS IN SOILS AMENDED WITH SEWAGE SLUDGE,

Terry, R. E.

Dissertation Abstracts International B, Vol. 38, No. 2, p 452-453, August, 1977.

The effects of soil characteristics, sludge management procedures, and environmental conditions on the decomposition rate of sludge in soils and on transformations in sludge-amended soils were investigated in laboratory experiments with synthetically-prepared sludges. Studies indicated that sludge decomposed rapidly during the first 28 days of incubation and slowly for the remainder of the incubation period. With synthetic sludges, 44% of the organic carbon was evolved as CO2 after 224 days of incubation as compared with 26-42% after 130 days for soil-applied municipal sludges. Although increased temperatures accelerated sludge decomposition, little effect was produced by soil pH, texture, and moisture content. Nitrification rates and the breakdown of native soil organic matter were increased in sludge-amended soils. Ammonia losses by volatilization in sludge-amended soils were greater in samples receiving multiple sludge applications and under conditions of high soil pH, rapid drying, and low clay content. Sludge addition resulted in higher concentrations of all nitrogen forms.

D063
FILTER SYSTEM SUCCESSFUL,

Water and Waste Treatment, Vol. 20, No. 7, p 9-10, July, 1977.

A Delavan-Watson fixed distributor nozzle system is being used on a nitrifying plant at the 20-mgd Wanlip Water Reclamation Works in England. The distributor nozzle system is being used to provide a constant spray of effluent over the filter bed. Standards for the system required Delevan-Watson to design a unit which was capable of giving an even distribution of 20.5 mgd of effluent at a nozzle pressure of 5 psi, and which could be adapted to a distribution of 36 mgd at 7 psi. Effluent from an activated sludge tank is pumped to a 300- x 150-m nitrifying filter. The fixed distributor nozzle system includes sectioned laterals which run the width of the filter bed and are spaced at 3-m intervals along the length of the bed. Cast iron pipes with puddle flanges and cast iron mono-flange butterfly valves comprise the initial sections of the laterals. PVC pipes are used for the remainder of the lateral. Detachable PVC spray nozzles are fitted on the six pipes.

D064
OXYGEN AERATION ADDS TREATMENT CAPACITY, UPS EFFICIENCY,

The American City and County, Vol. 92, No. 8, p 55-56, August, 1977.

Applications of the Arico F(3)O (Forced Free Fall Oxygen) system to sewage aeration are described. An Airco Model 1000 is being used at the Sheffield Hills waste water treatment plant in Wayne, New Jersey, to provide 1000 lbs of oxygen to two aeration basins. A gas-tight concrete module containing an axial flow pump, a system of weirs, and a nozzle is submerged in the covered aeration basin with the pump intake below the surface. Sewage is drawn downward into a distribution well and through a zone of oxygen-rich gas. Oxygenated mixed liquor is then returned to the aeration basin via a nozzle-like orifice at the base of the module, and unabsorbed oxygen is recycled through the module. High dissolved oxygen levels in the basin are maintained by continuous cycling through the module. A high-purity oxygen treatment system produced by the FMC Corporation for use in uncovered aeration basins is described. Oxygen is transferred to waste water by a horizontal rotating diffuser. Diffuser impellers maintain mixing and solids suspension and a dissolved oxygen probe monitors mixed liquor oxygenation in the FMC system.

D065
ELECTRIC EQUIPMENT FOR MUKOGAWA RIVER SEWAGE TREATMENT PLANT,

Yokomichi, K., Nagata, Y., Hatada, H., and Tomita, T.

Hanshin City Improvement Bureau,
Hyogo, Japan.

Toshiba Review, No. 109, p 5-12, May-June, 1977. 8 fig, 2 tab.

Operation of the Mukogawa River Sewage Treatment Plant is controlled and supervised by a large process computer, a TOSBAC-7000/25. The Mukogawa plant is designed to treat an average volume of combined municipal and industrial waste water of 570,000 cu m/day. Treatment facilities will include a pumping well, pre-aeration tank, primary settling tank, final settling tank, storm water settling tank, chlorination, sludge treatment, and sludge thickening. Pump well water level, aeration, return sludge volume, excess sludge volume, and power supplies will be controlled from a central supervisory control panel. Nine industrial television cameras will be used to observe various activities in the plant. Diagrams of apparatus layout in the control room, computer hardware system, supervisory control system, sewage treatment plant flow, and the control system for return sludge are provided. Vertical water flow meters and level meters will trigger changes in power intake and distribution, operation of the main facilities, treatment mode, and chlorine dosage. The computerized control system is designed for expansion to accomodate any future plant expansions.

D066
BASIC CONCEPTS IN DISINFECTION WITH OZONE,

Farooq, S., Chian, E. S. K., and Engelbrecht, R. S.

Miami University,
Coral Gables, Florida,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 8, p 1818-1831, August, 1977. 14 fig, 1 tab, 24 ref.

Inactivation studies with Candida parapsilosis and Mycobacterium fortuitum were conducted to examine the various parameters which might affect the disinfection efficiency of ozone in continuous flow systems. Parameters examined include pH, mixing, density of organisms, and organic matter. Results of laboratory studies indicated that the ozone residual in waste water controlled the degree of inactivation of microorganisms and that the presence of ozone bubbles enhanced disinfection. Greater ozone stability at low pH aided inactivation. Decreases in inactivation with more intense mixing were attributed to lower ozone residuals. Ozone demand and organism survival were greater at a high initial density of organisms, with more efficient disinfection at low densities. Studies on secondary waste water effluent with different fractions of organic material indicated that secondary effluents exerted much higher ozone demands than the deionized-buffered water which had been seeded with microorganisms for the laboratory studies. Greater ozone demands were observed for waste water which contained organic compounds with molecular weights in the fulvic acid range (150-18,000) than in the humic acid range (less than 150 or greater than 18,000). Low food:microorganism ratio in an activated sludge unit resulted in more efficient ozone disinfection.

D067
REDUCTION OF SALMONELLA, E. COLI, COLIFORMS AND FECAL STREPTOCOCCI BY CHLORINATION OF SEWAGE TREATMENT PLANT EFFLUENTS,

Kampelmacher, E. H., Fonds, A. W., and Van Noorle Jansen, L. M.

National Institute of Public Health,
Bilthoven, The Netherlands.

Water Research, Vol. 11, No. 7, p 545-550, 1977. 9 tab, 5 ref.

The reduction in bacteria during chlorination and phosphate removal was investigated for three sewage treatment plants in the Netherlands (Harderwijk, Elburg, and Bunschoten-Spakenburg). Influent samples from the facilities were monitored for Salmonella; effluent samples were measured for Salmonella, Escherichia coli, coliforms, and fecal streptococci. Concentrations of various Salmonella serotypes found in influent at the three facilities are listed. Concentrations of the serotypes in effluent before and after chlorination and in the receiving lake are presented. Disinfection efficiencies through the sludge flowing through an air-tight container. Static pressure is built up by the composting reaction and maintained at 1-6 atmospheres. A temperature of more than 55 C and less than 75 C is maintained within the air-tight tank as the composting reaction occurs.

C062

WASTEWATER TREATMENT,

Australian Patent 488,263. Issued November 24, 1977. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 47, No. 44, p 3990, November, 1977.

A raw waste water treatment process which reduces BOD levels through partial recycling of the denitrified effluent has been patented. The BOD content of the sewage effluent is reduced by aeration in an aeration chamber. Nitrogen compounds are oxidized to nitrates by biodegradation with aerobic microorganisms. The nitrates are conveyed to a denitrification zone where the nitrate-bearing waste water is denitrified. A part of the waste water containing nitrates which has been partially treated is returned and mixed with the raw influent in a facultative zone. This recycling of a portion of the waste water effects a BOD reduction in the raw effluent and a nitrate reduction in the recycled waste water.

C063

REGULATING OXYGEN INPUT IN TREATMENT OF EFFLUENT,

Gorski, T., Heinem, A., and Mack, K.

Bayer Aktiengesellschaft,
Leverkusen, West Germany. (assignee)

United States Patent 4,071,443. Issued January 31, 1978. Official Gazette of the United States Patent Office, Vol. 966, No. 5, p 1872-1873, January, 1978. 1 fig.

A patent has been issued for a waste water aeration treatment system which improves oxygen use and diminishes activated sludge particle size. Sewage effluent containing activated sludge is mixed in a double tank aeration chamber and oxygenated with a gas containing 20% oxygen. Gas bearing 40-80% oxygen by volume is introduced into the gas space within the first vessel containing the waste water. Gas is applied until the effluent has an oxygen content of 1-4 mg/liter. The aerated effluent is passed from the first tank into the second tank where the gas in the air space has an oxygen content of 30-60% by volume. The effluent is again sprayed with gas and oxygen until the oxygen content reaches 4-8 mg/liter. Effluent in the second tank is returned to the first treatment stage where it is mixed with fresh effluent in the amount of 10-300% by volume. Activated sludge solids are reduced to between one-third and one-twentieth of their original size by the shear force.

C064
CLEANING APPARATUS FOR SEWER PIPES AND THE LIKE,

United States Patent 4,073,302. Issued February 15, 1978. Official Gazette of the United Patent Office, Vol. 967, No. 2, p 473, February, 1978. 1 fig.

An apparatus for cleaning the interiors of sewage pipes and other conduits with compressed cleaning fluid has been patented. The cleaning apparatus consists of a tubular body containing a cylindrical bore with a nozzle at one end and an inlet conduit on the other. The conduit is connected to a supply of pressurized cleaning fluid which is sprayed into the pipes through the nozzle at the other end of the bore. The nozzle is divided into two chambers, the first having a larger diameter than the second. A wall separates the second chamber from the first chamber, equipped with a number of jets through which the cleaning fluid is discharged under pressure. The entire apparatus is mounted on two sets of hubs, each containing three legs. The legs have rotating wheels and pivotal skids which engage with the interior of the pipes. The skids may be rotated perpendicular to the tubular body of the apparatus.

C065
PROCESS AND APPARATUS FOR THE BIOLOGICAL PURIFICATION OF EFFLUENT,

Australian Patent 488,242. Issued November 24, 1977. The Australian Official Journal of Patents, Trademarks, and Designs, Vol. 47, No. 44, p 3985, November, 1977.

A biological treatment system using two interchangeable basins to aerate and settle waste water has been patented. The two connected basins have air-tight sealed inlets. Sewage effluent is introduced into the first basin, where it is injected with pure oxygen or oxygen-enriched air. Activated sludge is administered and the mixture is retained in the basin for a predetermined period. The aerated effluent is then passed into the second basin, where sedimentation of solids occurs. Clarified water is removed from the tank until the activated sludge level in the first basin decreases to a predetermined level. At this point, the process is reversed and the second basin is transformed into an aeration tank while the first basin operates as a sedimentation basin.

C066
TREATMENT OF EFFLUENT,

United States Patent 4,075,095. Issued February 21, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 2, p 1064-1065, February, 1978. 1 fig.

A patent has been issued for a settling tank containing a sand filter bed and scum trough for the separation of sludge from clarified water. The settling tank is divided into a scum tank and a ballast chamber. The scum tank contains a filter bed and medium on a perforated support at the top. Effluent is introduced into the tank through a feed valve located below the perforated filter. The effluent is fed into the filter and sludge settles to the lower portion of the scum tank. The filtered liquor is pumped through a scum trough. Scum is removed by the perforated support before effluent is discharged via a weir. The ballast chamber, located below the support, contains an outlet and a back pressure monitor. A valved gas outlet releases gas when a predetermined back pressure is attained. The filter is backwashed when required by dropping the level of effluent in the tank.

C067

SETTLING TANK SLUDGE COLLECTOR,

United States Patent 4,075,109. Issued February 12, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 3, p 1069, February, 1978. 1 fig.

A patent has been issued for a flat bottomed tank which provides settling and scraping of treated sewage sludge. The tank is equipped with a bracket mounted, electric motor-driven bridge which traverses the length of the chamber. A wheel containing a pneumatic tire rotates around a vertical axis attached to the bridge and parallel to the tank wall and operates by the bridge motor. The tire is maintained in contact with the adjacent wall by a gravitational force established by a rotating plate connecting the support bracket to the wheel and motor. A sludge scraper frame equipped with a transverse center bar and a scraper blade is mounted on one of the longitudinal side members of the frame; it is supported in a horizontal position by the bridge. During sludge scraping, the sludge scraper rotates about an inclined axis as it moves toward a sump at one end of the tank. The scraper returns to an idle position as it moves away from the sump. An elongated, curved cam plate, projecting out from the end wall to the side of the scraper frame, controls the angle of the sludge scraper frame.

C068

RESIDUES DEWATERING DURING WATER AND SEWAGE TREATMENT--BY FREEZING WITH COOLING AGENT LAYERWISE AND MELTING TO DEPOSIT RESIDUES,

Soviet Patent SU-546-566. Issued March 3, 1977. Derwent Soviet Inventions Illustrated, Vol. A, No. 1, p 1, February, 1978.

A patent has been issued for a dewatering process in which residues from waste water treatment plants are frozen in a column with a cooling agent, such as n-butane; liquids are melted and decanted in the same column. The residues are introduced into the top of a column in which the cooling agent flows upwards. The n-butane has a density of 0.5-0.85 g/cu cm and a specific gravity of 0.605 g/cu cm at -5 C. Depending upon column height, the temperature varies from -10 to 4 C over 0.1-3 min in the cooling zone and from 0-4 C over

0.1-6 min in the melting zone. For residues containing hydroxides, aluminum salts, organics, and mineral materials, 250 liters of the cooling agent is added to the column for 14 liters of de-aerated liquid. The liquid effluent sinks to the bottom of the column where the temperature is 1.5 C; vapor forms in the top layer where the temperature is -9 C. Ice particles formed in the upper layer drop through the liquid levels, carrying residue particles to the bottom layer where they melt. Vacuum filtration removes the residue particles; the liquids are separated according to their specific gravities. The cooling agent is condensed and reused. Dewatering is increased by performing freezing, melting, and decanting in the same column.

C069

PRESSING LIQ. FROM SLUDGE ESP. SEWAGE SLUDGE--IN DECREASING GAP BETWEEN TWO RISING SURFACES E. G. DRUM AND BELT,

French Patent FR-2343-701. Issued November 10, 1977. Derwent French Patents Abstracts, Vol. A, No. 1, p 3, February, 1978.

A patent has been issued for a sludge dewatering device consisting of impermeable membranes or filter screens mounted on a drum and a conveyor belt. The device provides lateral water removal as well as screen filtration. The impermeable pressing surface is mounted on the circumference of a rotary drum. The second surface is a perforated, continuous conveyor belt which is driven by a motorized pulley. Increasing contact between the drum and belt as the sludge moves from the inlet to the outlet provides increasing pressure. As the pressure increases, the water in the sludge is expelled laterally from the press surfaces and is blown into a collection tank by compressed air jets. The press reduces filter screen clogging by allowing more water to escape laterally from the sludge.

C070

PACKAGED PLANT FOR PHYSICOCHEMICAL PURIFICATION OF WASTE WATER--WITH GRAVITY EVACUATION OF SLUDGE FROM FLOCCULATING AND DECANTING ZONES,

Belgian Patent BE-858-720. Issued January 2, 1978. Derwent Belgian Abstracts, Vol. A, No. 3, p 4, February, 1978.

A physicochemical waste water treatment plant that separates liquids and solids and discharges settled sludge by gravity flow has been patented. The packaged treatment plant is contained in a three compartment steel tank. An upper rectangular compartment coagulates and neutralizes the incoming waste water. The liquid is passed beneath partitions into a flocculation and separation chamber having walls inclined toward the third compartment. Baffles mounted on the inclined walls of both the second and third chambers reduce the velocity of the inflowing waste water. Solids separated in the flocculation compartment are evacuated by gravity flow to the third decantation and sludge disposal chamber. The plastic baffles mounted in the lower chambers are inclined at an angle of 55-60 degrees to the walls. The treatment plant has a flow capacity of 1-50 cu m/hr and provides economical installation and operation.

C071

AEROBIC BIOLOGICAL PURIFICATION OF FLUID WASTES--BY INTENSIVE CIRCULATION IN TANK CONTG. HIGH CONC. OF MICROORGANISMS,

French Patent FR-2342-254. Issued October 28, 1977. Derwent French Patents Abstracts, Vol. Y, No. 50, p 4, January, 1978.

A patent has been issued for an activated sludge aeration process which employs intensive circulation and high microbial concentrations to treat organic waste water. Waste water is introduced through an overspill into an aeration tank containing a bacteria count of 10,000-100,000 mg/liter. Air is mixed with the liquid as it is pumped through a distributor into the tank. The aerated waste water is fed into the tank at a rate rapid enough to promote intensive circulation. Constant circulation in the tank is maintained by sprinklers, connected to the pump, which spiral the waste water back into the tank. The liquid is delivered to a flotation tank where a centrifugal decanter removes sludge from the waste water for recycling. The clarified water is removed via an outlet at the bottom of the tank. The process does not require compressors or filters, reduces operating and capital costs, and produces a dewatered sludge.

C072

FILTRATION MEDIUM FOR BIOLOGICAL TREATMENT OF WASTE WATER--SUPPORT ESP. OF PLASTIC COATED WITH GRANULAR MATERIAL,

Belgian Patent BE-855-426. Issued December 6, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 50, p 1, January, 1978.

A patent has been issued for a plastic-supported biological filtration system having a granular coating which effectively increases the surface area available for microorganism growth. The waste water is treated in an aerated filter coated with a granular material, such as activated carbon and sand. The surface area of the roughened activated carbon coating is increased by a factor of 30,000. The granular surface of the biological filter provides a more conducive environment for microorganism attachment. The filtration medium is mounted on a plastic or ceramic material, such as polyvinyl chloride, polystyrene, or polypropylene. The granular activated carbon coating on the filter media is also more effective in the treatment of chemical contaminants in the waste water.

C073
SEWAGE SLUDGE TREATMENT BY STEAM--USING COMPRESSED AIR TO PREVENT BUBBLE ESCAPE,

French Patent FR-2343-703. Issued November 10, 1977. Derwent French Patent Abstracts, Vol. A, No. 1, p 3, February, 1978.

A patent has been issued for a heat treatment process for sewage sludge clarification. Steam and compressed air are introduced simultaneously into a sludge reactor. The escape of air bubbles from the reactor is prevented by the flow of compressed air distributed evenly over the surface of the sludge. After heat treatment, clarified water is separated from the sludge and decanted from the reactor for treatment in an activated sludge tank. Noxious gases produced during heat treatment of the sewage sludge are deodorized. The unit is self-contained and does not require high temperatures.

C074
SEWAGE SLUDGE DISPOSAL,

Wagner, W. F.

Thiokol Corporation,
Newtown, Pennsylvania. (assignee)

United States Patent 4,073,242. Issued February 14, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 2, p 454, February, 1978. 1 fig.

A patent has been issued for a sludge disposal system in which dewatered sludge is incinerated in small, regulated amounts. The effluent is passed through a sieve for liquid-solids separation; the sludge is pulverized. The dewatered and ground sludge, with a uniform density and consistency maintained by agitation, is pumped at a high velocity from the sludge collection tank through a pipe back into the collection tank. The velocity of the agitated sludge in the pipe is great enough to prevent clogging. Small amounts of sludge are occasionally diverted to a second pipe at the same velocity but a smaller volumetric flow. Sludge in the second pipe is conveyed to an incinerator where compressed air sprays the sludge into the combustion chamber. The volume of sludge sprayed into the incinerator is less than the volume of sludge flowing through the first pipe. The smaller volume of sludge that is periodically combusted allows for a smaller incineration unit than would be necessary were the entire volume of sludge in the first pipe incinerated.

C091

LIQUID WASTE TREATMENT APPARATUS,

United States Patent 4,082,662. Issued April 4, 1978. Official Gazette of the United States Patent Office, Vol. 969, No. 1, p 269, April, 1978.

A patent has been issued for a waste water pretreatment process employing aeration. The waste water is pumped horizontally through a nozzle with a reduced diameter into an aeration tank which has an equilateral, elongated cross section. The organic solids in the waste water are broken up by the shearing action of the influent as entrained gas is released. Air is aspirated into the aeration chamber through the area around the influent nozzle and mixed with the liquid waste by the turbulent action in the aeration chamber. Further mixing of the air and waste water to release the entrained air and break down the organic solids is accomplished by passing the wastes into a mixing chamber with a larger cross section maintained at ambient pressure.

C092

SLUDGE THICKENING APPARATUS,

Kelly, E. M.

Envirotech Corporation,
Menlo Park, California. (assignee)

United States Patent 4,082,671. Issued April 4, 1978. Official Gazette of the United States Patent Office, Vol. 969, No. 1, p 272, April, 1978. 1 fig.

A patent has been issued for an apparatus which thickens primary and secondary sewage sludge. An open top tank is equipped with a vertical, tubular upper inlet for the introduction of aerated secondary sludge into the thickener. Below the inlet, a second feedwell passes primary sludge into the tank below the secondary sludge. The upper inlet has a closed bottom and an open top, while the reverse is true for the lower, adjacent inlet. Mounted within the tank and extending radially from the upper feedwell is a circular partition which divides the tank into concentric portions. A liquid extraction apparatus mounted on the tank wall withdraws liquid from the outer ring of the tank to maintain a constant fluid level. Within the center ring area, floating solids on the surface of the confined liquid sludge are removed. A valve at the bottom of the tank collects and removes solids which settle from the liquid.

C093

FILTER FOR REMOVING RESIDUES FROM DOMESTIC SEWAGE--COMPRISES MULTILAYER FILTER BEDS IN WHICH THE PARTICLES OF CHARGE DIMINISH,

Soviet Patent SU 552-096. Issued April 15, 1977. Derwent Soviet Inventions Illustrated, Vol. A, No. 6, p 1, March, 1978. 1 fig.

A multilayer, charged particle filtration system with a variable velocity gradient for removing suspended solids from domestic wastes has been patented. The system consists of a conical shaped body with internal horizontal gratings for supporting the charged filtration medium and an externally-mounted centrifugal pump at the base. Each layer of charged particles in the filter has the same hydraulic size. The particle size in each ascending filtration layer diminishes as the upward flow of liquid approaches the top of the unit. Waste water is introduced through a pipe at the base of the system by the centrifugal pump. The effluent passes upward through a distribution system into the layers of charged filter particles. The rate of filtration with respect to the hydraulic particle size within each layer is calculated as the critical flow rate multiplied by a coefficient in the range of 1.02-2.8. The flow rate of the waste water through the layers is adjusted so that the relative mobility of the charged particles is equivalent to the maximum absorption capacity of the particles in each layer; minimum relative mobility of the particles is maintained. The filter is regenerated when the layers contain the capacity load of residue from the waste water by pumping wash water upwards through the layers in the direction of waste water flow during filtration.

C094

BACK FLUSHING FILTER FOR SEWAGE ANALYSER--WITH SEMICIRCULAR DEFLECTOR IN CENTRAL SECTION FLANKED BY SINTER FILTER DISCS,

Netherlands Patent NL 7707-801. Issued January 17, 1978. Derwent Netherlands Patents Report, Vol. A, No. 5, p 7, March, 1978.

A back-flushing filter system employing sintered filter discs to clear sewage upstream of a water quality meter in a waste water flow has been patented. The system contains sintered filter discs on either side of a central section; the discs are positioned beneath covers to clarified water outlets. The central section is equipped with a peripheral inlet for introducing raw waste water. The influent strikes a semicircular, perforated deflector plate located in the central section. The filter discs are backwashed by blocking one of the clarified water outlets with compressed air. As the other filter disc becomes operational, the filter cake formed on the first filter disc is washed away by a back flow of clarified water. The system reduces the need for frequent replacement of the filters and extends the filters' functional life span.

C095

DISEASE GERM TREATMENT FOR SEWAGE SLUDGE--BY PURE OXYGEN CONVERTED BY ELECTRON BEAM TO OZONE BUBBLING THROUGH SEWAGE LAYER,

German Patent DS 2546-756. Issued March 9, 1978. Derwent German Patents Abstracts, Vol. A, No. 11, p 3, April, 1978.

A patent was issued to Werner and Pfleiderer for a continuous process to disinfect sewage sludge. A thin layer of sludge is transported on a conveyor channel which is equipped with a device to maintain an even sludge layer thickness. Oxygen-bearing gas is bubbled through the sludge layer via the nozzle base formed by the flat bottom of the sludge conveyor channel. The sludge layer, agitated by the gas, is subjected to an electron beam source which produces ozone. The gas is immediately drawn off and reapplied to the sludge on the conveyor via a suction nozzle connected to the nozzle base.

C096

LIQUID ACTIVATED SLUDGE TREATMENT--IN TANK WITH ELECTRODE SYSTEM PRODUCING GAS BUBBLES SAVES POWER BY SULPHURIC ACID ADDITION,

French Patent FR 2348-891. Issued December 23, 1977. Derwent French Patents Abstracts, Vol. A, No. 6, p 9, March, 1978.

An activated sludge treatment process which incorporates sulfuric acid conditioning, flocculation, and electrode-generated bubbling has been patented. The activated sludge is first adjusted to pH 2.5 with additions of sulfuric acid; acidity is monitored with a pH meter. The sludge flows through a pipe into a treatment tank containing two cathodes, mounted above the bottom plates, and anodes, formed by parallel rods. These electrodes generate bubbles which float suspended solids in the form of scum to the surface of the tank. The sulfuric acid addition permits a higher sludge throughput, thereby reducing the electrical power costs of the treatment system.

C097

LOW-PRESSURE SEWAGE SYSTEM FOR BUILDINGS--USES LARGE VENTILATED BACK-PRESSURE TANK, TO PREVENT FLOODING,

German Patent DS 2653-713. Issued March 2, 1978. Derwent German Patents Abstracts, Vol. A, No. 10, p 8, April, 1978. 1 fig.

A patent has been issued for a ventilated back-pressure tank system connected to a low-pressure sewage system designed for individual buildings. Waste water from the fixtures within the building flows through gravity pipes to a collection tank which adjoins a low-pressure sewage conduit. When the waste water level in the tank reaches a maximum, a blocking valve automatically opens to release the effluent into the sewage conduit. A back-pressure tank, located below the building fixtures and above the maximum level of the collection tank, is connected by a conduit to the gravity pipe from the building.

The back-pressure tank has an open blocking element at its base where the conduit enters for ventilation from the surface to prevent flooding.

C098
SEWAGE DISPOSAL SYSTEM,

Australian Patent 490,208. Issued February 16, 1978. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 48, No. 5, p 406, February, 1978.

A sewage disposal system has been patented for water closets designed to incorporate a reusable non-aqueous flush medium with a specific gravity lower than water. The medium bearing the wastes is flushed to a separating tank equipped with a sewage inlet at the top. In the separating tank, the flushing medium floats to the top because of its lower specific gravity while the sewage settles to the bottom of the tank. Attached to the separating tank is a transfer apparatus for removing the settled sewage from the tank. A sewage level sensor is mounted in a branch conduit located outside the separating tank. When a specified sewage level is detected in the separating tank by the sensor, the sewage transport system is activated to remove the sewage. Minimum loss of the flushing medium is achieved with this process.

C099
PROCESS FOR THE DISPOSAL OF SEWAGE,

Opferkuch, R. E., Jr., and Wong-Chong, G. M.

Monsanto Research Corporation,
Saint Louis, Missouri. (assignee)

United States Patent 4,076,620. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1570, February, 1978. 1 fig.

A sewage treatment system employing lime and carbon dioxide additions has been patented. Trash and other objects in the sewage are removed by a degritter before lime is added at a 1:1 ratio with COD to the effluent. At least 500 ppm lime is added to the sewage to assist in carbonation and in separation of the solids from the liquid effluent. Lime coagulation is maintained for 30 min or less to promote a Jackson Turbidity Unit of less than 50 in the separated sewage. The effluent is treated with carbon dioxide to adjust the pH to 10.6-11.2 and the solids are allowed to settle for 30 min. The solids are separated from the liquid fraction and concentrated for further dewatering. The concentrated solids and the settled solids are adjusted to pH 6-8 with carbon dioxide and discharged.

C100

ACTIVATED CARBON TREATMENT OF OXYGENATED WASTEWATER,

Conway, R. A., Lawson, C. T., and Stankewich, M. J., Jr.

Union Carbide Corporation,
New York, New York. (assignee)

United States Patent 4,080,287. Issued March 21, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 3, p 1092, March, 1978. 1 fig.

A patent has been issued for a waste water oxygenation process utilizing activated sludge and carbon. Effluent bearing biodegradable organics is introduced into an enclosed oxygenation zone and mixed with activated sludge and a feed gas containing 50% oxygen. Carbonaceous materials are biochemically oxidized, reducing the BOD of the oxygenated supernatant. Vent gas, containing 20-70% oxygen, is withdrawn from the tank; the oxygenated liquor is separated from the activated sludge and residual contaminants. A portion of the activated sludge is returned to the oxygenation zone; the effluent is passed upward through an activated carbon absorption zone where the depleted vent gas is added to provide a dissolved oxygen level of 2 ppm to maintain aerobic biological conditions within the activated carbon column. Residual organic contaminants in the effluent are absorbed or biologically oxidized within the activated carbon absorption zone.

C101

CENTRIFUGAL SEWAGE PUMP,

Tsukube, S.

Kabushiki Kaisha Sogo Pump Seisakusho,
Osaka, Japan. (assignee)

United States Patent 4,076,179. Issued February 28, 1978. Official Gazette of the United States Patent Office, Vol. 967, No. 4, p 1427, February, 1978. 1 fig.

A centrifugal sewage pump consisting of a semi-open impeller with a disk-like impeller shroud has been patented. The shroud has multiple impeller vanes and is mounted on a pump shaft. The front face of the impeller shroud contains depressions forming annular inner and outer edges. The outer edge of the shroud is covered with a shroud ring of a pump casing. Each impeller vane on the front face of the shroud disk extends out from the shroud and has a smooth front edge. An inner face casing, located in front of the impeller, surrounds a suction valve for removing solid wastes. The height of the impeller's outer periphery is 30-70% of the water passage clearance between the inner face casings. Two portions of the shroud front face are located in symmetrical positions without backward depressions.

C102

METHOD OF TRANSFORMING SLUDGE INTO ECOLOGICALLY ACCEPTABLE SOLID MATERIAL,

United States Patent 4,079,003. Issued March 14, 1978. Official Gazette of the United States Patent Office, Vol. 968, No. 2, p 654, March, 1978.

A patent has been issued for a process to convert liquid sludge which contains bacteria, viruses, and toxic soluble compounds into a solid, friable, odorless material. The sludge is introduced into one end of an elongated tank at a specific rate; calcium oxide is introduced at another rate. The sludge reacts with the calcium oxide in an exothermic manner as the materials move toward one end of the tank. The exothermic reaction generates steam and forms a solid, friable, odorless sludge cake with a pH of 12. The alkaline conditions and the heat produced by the reaction inactivate the bacterial and viral organisms and transform the water soluble compounds into insoluble form. The steam is removed from the tank and the solids reaction product is withdrawn from the end of the tank.

C103

COMPOSITION AND METHOD FOR DISPERSING FLOCCULANT POLYMERS,

Chambers, B. C.

Chemed Corporation,
Cincinnati, Ohio. (assignee)

United States Patent 4,089,831. Issued May 16, 1978. Official Gazette of the United States Patent Office, Vol. 970, No. 3, p 1039, May, 1978.

A process for dispersing high molecular weight flocculant polymers or copolymers to prevent agglomeration in waste water has been patented. The flocculant polymers or copolymers are mixed with a free flowing powdered inert material and water. The inert substance is added as 10-80% of the weight of the flocculant polymer; water is added to 0.10-20% of the weight. When the polymer solution, containing the inert powder, is introduced into water, the solubility of the flocculant is decreased. As the solution rate slows, the solids disperse and separate. Dispersion of the solid particles in the flocculant polymers prevents the agglomeration of the polymers or copolymers.

C104

METHOD FOR TREATING SEWAGE,

United States Patent 4,089,761. Issued May 16, 1978. Official Gazette of the United States Patent Office, Vol. 970, No. 3, p 1022, May, 1978. 1 fig.

A patent has been issued for a biological waste water treatment process in which oxygen and hydrogen are generated by electrolysis. Influent raw sewage is comminuted to an aqueous slurry and introduced into a digester containing rim outlets. Waste water is conveyed along the hollow rotor shaft to a separator having insert vanes. As the waste water is passed into the separator, sludge is drawn through the channels along the rotor and piston. Sludge accumulates on a deposit pad located beneath the separator inserts. When sufficient sludge accumulates to reach the inserts, the piston is automatically activated. The piston descends, forcing the sludge from the deposit pad through an outlet.

C124

PURIFYING WASTE WATER OF HIGH ORGANIC CONTENT - FIRST ACID ANAEROBIC, THEN AEROBIC, THEN ANAEROBIC METHANE FERMENTATIONS,

French Patent FR 2364-184. Issued May 12, 1978. Derwent French Patents Abstracts, Vol. A, No. 23, p 4, July, 1978.

A patented process reduces the organic content of waste water with combined anaerobic and aerobic digestion. The highly organic waste water is anaerobically digested in an acid medium which supports a microbial culture to convert contained oxygen to an organic acid mixture; fermentation occurs at a temperature of 20-50 C over a residence time of 0.1-0.8 days/kg/cu m. The acidity of the waste water during anaerobic digestion inhibits methane fermentation. The waste water is then treated by aerobic fermentation for a residence period of 0.2-0.3 days/kg/cu m, followed by anaerobic methane digestion for 6-15 days. Neutralization with an alkali is not required because acid is converted to CO_2 and H_2O by the process. The treated effluent may be further aerobically digested after the anaerobic methane digestion stage.

C125

APPARATUS FOR USE IN WATER PURIFICATION PARTICULARLY SEWAGE TREATMENTS,

White, E. B., and Sharma, M. N.

Filters International, Incorporated,
Chicago, Illinois. (assignee)

United States Patent 4,100,070. Issued July 11, 1978. Official Gazette of the United States Patent Office, Vol. 972, No. 2, p 717, July, 1978. 1 fig.

A unit incorporating primary, secondary, and tertiary filtration/adsorption treatment of municipal sewage has been patented. The unit contains a primary aeration tank with a secondary settling zone. Secondary effluent is contained in a receiving tank connected by a conduit to an inlet at the base of the tertiary treatment unit. Tertiary treatment is accomplished by upflow filtration through a mixed bed of particles decreasing in size toward the upper layers. Filtration is followed by adsorption on an activated carbon bed located above the mixed bed filter. An oxygen-bearing gas, introduced under pressure at the base of the tertiary unit, aerates the effluent as it is forced upwards through the filtration/adsorption beds. An outlet at the top of the tertiary unit conveys excess renovated effluent to a storage tank and returns the remainder to the receiving tank. Valves, mounted in the conduits leading to and from the receiving and storage tanks, control the flow of effluent to the tertiary system. Effluents from the receiving and storage tanks are redirected through the tertiary system to regenerate the mixed bed and the activated carbon.

C126

METHOD AND APPARATUS FOR THE BIOLOGICAL CLEANSING OF WASTE WATER,

Hartmann, L.

Maschinenfabrik Hellmut Geiger,
Karlsruhe-West, West Germany. (assignee)

United States Patent 4,100,063. Issued July 11, 1978. Official Gazette of the United States Patent Office, Vol. 972, No. 2, p 715, July, 1978. 1 fig.

A patented trickling filter unit maintains a preset level of municipal waste water sprayed into the apparatus for biological treatment. Waste water is sprayed through the top of the trickling filter housing over a biological mass suspended on vertical supports; the biomass is located above the preset waste water level to prevent immersion. Outlets located between the vertical supports continuously remove a portion of the biomass as sludge. Below the sludge outlet is mounted a second discharge duct to remove the treated waste water. The water level in the unit is maintained between these two outlets. The treated effluent is continuously discharged from the system through the second discharge duct.

C127

PROCESS FOR CONDITIONING SEWAGE SLUDGE,

Australian Patent 492,957. Issued May 25, 1978. The Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 48, No. 18, p 1672, May, 1978.

A process has been patented for sterilizing sludge at high temperatures to condition it for land disposal. The sludge is initially heated within a temperature range of 65-150 C for a period between 30 sec and 60 min. When the sludge is treated in the higher temperature ranges, the shorter time periods are used. After the sewage sludge has been thermally sterilized, it is biologically treated by digestion at a temperature of 32-60 C. This conditioning process, which prepares the sludge for land disposal, is suitable for domestic as well as farm wastes.

C128

SEWAGE BIOCHEMICAL PURIFICATION APPTS. - HAS MAIN TANK FILLED WITH PERFORATED PLASTIC FILM ON WHICH THE BIOMASS FORMS,

Soviet Patent SU-567-675. Issued August 26, 1977. Derwent Soviet Inventions Illustrated, Vol. A. No. 24, p 10-11, July, 1978. 1 fig.

A patented biochemical waste water treatment system supports an excess of biomass on a perforated plastic film mounted on vertical screens. Raw waste water flows through a pipe into a storage tank containing recirculated effluent. The mixed liquor is pumped into the treatment tank through a pipe terminating in a sprinkler distribution system. As the waste water flows down through the perforated plastic film, it becomes saturated with air. The air-saturated effluent and biomass collect in a chamber below the vertical screens for further treatment. Treated effluent collects in channels located around the periphery of the treatment tank; it is allowed to settle before it is drawn off through another pipe. Unoxidized biomass and a portion of the effluent are returned to the storage tank for mixing with raw influent.

C129

CLEANING RAKE ARRANGEMENT FOR A DRAIN CHANNEL GRID - IS OF LOW, STABLE CONSTRUCTION AND SUITABLE FOR GRIDS WITH STRAIGHT BARS,

German Patent DS 2608-774. Issued May 24, 1978. Derwent German Patents Abstracts, Vol. A, No. 22, p 3, July, 1978.

A cleaning rake for clearing sewer gratings is suitable for sewer grids with straight bars. The rake apparatus has teeth which slant about a horizontal axis and are attached to a rake arm unit which also pivots about a horizontal axis. Vertical motion of the rake arm is provided by a drive mechanism on the underwater side of the sewer grate. The arm assembly is mounted with its pivot shaft located along a curved guide track, forming a two-armed lever. The apparatus is driven by a continuous chain containing fixed sprockets which are located along the guide track and connected to the rake arm. The arm is attached to the side of the pivot shaft by a swinging bearing and to the free end of a swinging support. The cleaning rake apparatus can be moved to an inoperative position, a cleaning mode, and a horizontal discharge position for disposing of the materials to a collection system.

C130

FLOCCULATING AND DRAINING SLUDGE FROM EFFLUENT PURIFICN. PLANT - IN LOW COST LOW ENERGY POTENTIALLY MOBILE FILTER PLANT,

French Patent FR 2363-524. Issued May 5, 1978. Derwent French Patents Abstracts, Vol. A, No. 22, p 4, July, 1978.

A rotating drum apparatus flocculates and filters sewage sludge, producing a homogeneous, dewatered product. The sewage sludge is flocculated in a rotating drum with a central inlet and outlet. Surrounding the flocculation drum and sharing the same axis is a counter-rotating filter drum. As the inner drum rotates, filtrate passes through perforations in the drum wall and is distributed laterally by a series of paddles and deflectors attached to the drum walls. The filter drum contains a continuous filter band pressed against the drum's periphery by an outer driving filter band; successive filter band configurations are zig-zagged between pressure rollers. The system is amenable to packaged, mobile operation at several sites and provides simple operation with minimum maintenance and supervision.

C131

SEPARATOR OF ACTIVE SLUDGE FROM TREATED EFFLUENT - HAS FILTERING ELEMENTS WITH POSITIVE CONALITY SET VERTICALLY DIRECTLY ABOVE DISTRIBUTOR,

Soviet Patent SU-565-885. Issued July 21, 1977. Derwent Soviet Inventions Illustrated, Vol. A, No. 23, p 4, July, 1978. 1 fig.

An aeration and filtration system to separate activated sludge from treated effluent has been patented. The separation unit consists of a reservoir tank containing vertical filter elements located above a water-air distribution system. Influent is introduced along a pipeline at the tank base into the distributor, along with previously treated effluent bearing dissolved air at 3-4 atmospheres. The waste water is evenly distributed over the bottom of the reservoir tank and passed upwards through filter elements which have positive slopes in the range of 1:20-25. As the effluent rises, suspended particles are entrapped in air bubbles and compacted on the filters. Concentrated sludge is scraped from the filters and discharged through a trough. Treated effluent is removed through an annular outlet for partial recirculation with influent. The surfaces of the filter elements are continuously regenerated by the upward movement of the air bubbles.

C132

APPARATUS FOR PURIFYING SEPTIC TANK EFFLUENT,

United States Patent 4,104,166. Issued August 1, 1978. Official Gazette of the United States Patent Office, Vol. 973, No. 1, p 278, August, 1978. 1 fig.

A septic tank waste treatment system which purifies filtered effluent in a series of ozonation tanks has been patented. A large tank, laid adjacent to the septic tank, contains a smaller filter through which septic tank effluent passes at atmospheric pressure for solids removal. The filter tank inlet is connected to a septic tank effluent conduit; the effluent passes through a filter towards an outlet at the opposite end of the filter tank. Connected to the outlet are multiple ozonation tanks arranged in series within the large tank. The ozonation tanks, connected to an external gas supply system, are arranged to form a 16-ft long configuration. Effluent passing through the last tank in the series is discharged into the storage area formed by the unoccupied space between the large exterior tank and the filter and ozone tanks. Excess treated effluent is discharged from the storage space through an outlet leading from the last ozonation tank to a soil disposal field.

C133

REACTION WHEEL WASTE WATER SPRAY FOR PERCOLATING FILTER BED - SPRAYS TWO CONCENTRIC BEDS FROM DIFFERENT SOURCES OF LIQ.,

French Patent FR 2364-066. Issued May 12, 1978. Derwent French Patents Abstracts, Vol. A. No. 23, p 3, July, 1978.

A patented reaction wheel sprayer system permits simultaneous spraying of liquids from two separate sources onto concentric trickling filter beds. Two coaxial sets of radial spray arms, mounted on the reaction wheel, rotate the wheel horizontally to distribute the effluent. A vertical central pipe supplies liquid to one set of spray arms connected to a rotating hollow hub with sleeves. An annular rotary jacket, coaxially encasing the hollow hub, provides a channel for the liquid supplied to the second set of radial arms. The reaction wheel assembly is rotary seal-mounted on a fixed support box which conveys the liquid effluent to the rotary jacket. The reaction wheel system permits the space-saving concentric filter bed configuration via its ability to simultaneously or separately distribute two different effluents. The spray arms are designed to rotate independently or integrally, depending upon the fixed or rotating attachment of the rotary jacket to the hollow hub.

C134

TRAVELLING SLUDGE SCRAPER BRIDGE FOR - EFFLUENT TANKS,

German Patent DS 1957-685. Issued May 24, 1978. Derwent German Patents Abstracts, Vol. A, No. 22, p 1, July, 1978.

A sludge scraper bridge apparatus has been patented for dual waste water tanks. One end of the sludge scraper mechanism is supported on a winch-driven trolley located on the central partition between the tanks. The winch is directed by a circular guide pipe. The sludge scrapers are mounted on two webs attached to either side of the trolley. The other end of the scraper bridge assembly is supported by three radial guide rollers on the outer treatment tank wall; one guide roller is mounted on a horizontal axis. The free ends of the two scraper webs have free-moving castors which roll along the tank wall. The simple design of the scraper bridge provides efficient operation, even under heavy snow conditions.

C135
ELIMINATION OF ODORS FROM ORGANIC WASTES,

Weiss, J.

Weiss and Company,
Stockholm, Sweden. (assignee)

United States Patent 4,108,771. Issued August 22, 1978. Official Gazette of the United States Patent Office, Vol. 973, No. 4, p 1820, August, 1978.

A process for eliminating odor-producing organic compounds from domestic wastes, organic industrial wastes, and sewage sludge by means of an aqueous acid solution and an oxidizing agent has been patented. The wastes are mixed with a sufficient volume of an aqueous solution containing alkali metals, 3-25% by weight sulfuric acid, 3-20% by weight of an oxidizing agent, and 10-40% of a sulfur precipitating agent. The oxidizing agent is selected from a group of water soluble compounds including persulfates, nitrates, and chlorates; permanganates of ammonium and alkali metals are added to oxidize and deodorize the wastes. The sulfur precipitating agent is selected from the water soluble ferrous or ferric compound groups. The waste water is maintained at a pH of 6.5 or less during deodorization.

C136
APPTS. FOR FORMING SEWAGE TREATMENT SILICATE PRODS. - INCLUDES MIXING TUBE WITH STATIC HIGH SHEAR DEVICE,

Netherlands Patent NL 7614-162. Issued June 22, 1978. Derwent Netherlands Patents Report, Vol. A, No. 27, p 1, August, 1978.

A high-shear mixing tube apparatus has been patented for the production of a complex aluminum silicate compound used for coagulating waste water. The mixing tube is equipped with two or more inlets, one outlet, and stationary shear devices located along the internal channel. Water is fed into the second inlet and a soluble aluminum salt is introduced into the tube through one of the other inlets. The inner baffles cause the two feed streams to spiral through the tube and mix to form a stable aqueous dispersion which is recovered at the outlet. The outlet solution pressure is about 40 lbs/sq inch less than the initial inlet pressure. The static shear mixing of the solutions produces a material containing up to 5% silicate as SiO_2 with a pH ranging 3.0-7.5, determined by the silicate content; the dispersion product, used as a coagulant in waste water treatment, is soluble in hydrochloric acid. The static configuration of the mixing apparatus provides high shear mixing with low control requirements.

and entrained materials from 3-300 mm in size. Collected solids are ejected to a collector to provide continuous filtering with minimal supervision and maintenance. Designed as an alternative to conventional bar or rotary screens, the Aqua-Guard contains an endless belt of interconnected filter elements which move around an upper sprocket. Aqua-Guard is suggested for use in industrial water and waste treatment, and for removal of trash from sewage influent. The filters are capable of handling up to 465,000 gal/min to remove up to 560 tons of trash/hr, and are available in a variety of screen sizes.

D015

ADVANCED WASTEWATER TREATMENT INCLUDES REVERSE OSMOSIS,

Public Works, Vol. 108, No. 9, p 166, September, 1977.

A water reclamation and groundwater injection project of the Orange County Water District in California is described. Water Factory 21, an advanced waste water treatment plant, provides injection water to prevent intrusion of sea water into the area's groundwater supply. The facility includes chemical clarification, ammonia stripping, recarbonation, multi-media filtration, carbon adsorption, chlorination, and a reverse-osmosis demineralization plant. The reverse osmosis system treats effluent from either the activated carbon columns or the mixed-media filter beds, to provide 85 gal of permeate for underground injection for every 100 gal of effluent treated. Treated effluent is pumped to a series of 23 multi-casing injection wells to prevent sea water intrusion and augment Orange County's groundwater supply.

D016

PRODUCES HIGH SOLIDS CAKE FROM DILUTE SLUDGE,

Chemical Processing, Vol. 40, No. 10, p 53, September, 1977.

The Magnum dewatering press, which is produced by Parkson Corporation of Fort Lauderdale, Florida, is used to reduce the water content of sludges from waste water treatment. The dewatering process includes a draining stage, a low pressure stage, and a high pressure stage. Sludge which has been preflocculated with a polyelectrolyte is drained on a screen by light rolling and plowing. In the second stage, drained sludge on the screen is forced against a pressing screen by a series of decreasing diameter rollers, which gradually increase the pressure on the sludge. Very high pressure, created by 1" wide flat belts which press the sludge against a perforated roller, is used in the final stage of dewatering. The press is available in four widths, from 20" to 40", and produces a filter cake with a much lower water content than that in cakes from a conventional belt filter press.

D017
MICROSCREEN INNOVATION,

Filtration and Separation, Vol. 14, No. 4, p 412, July/August, 1977. 1 fig.

A series of rotary drum microscreens for water and sewage tertiary treatment is being produced by Paterson Candy International Ltd. of London, England. The microscreens may be used for storm water overflow treatment, final effluent polishing, BOD and turbidity removal, algae and plankton removal, and raw water straining. Available in standard diameter sizes of 1800, 2500, 3000, and 3700 mm and in lengths up to 5000 mm, the microscreen consists of a rotating open-ended horizontal drum supported on an A-frame. Raw waste water entering the drum's open end is filtered by the replaceable filter panels which are covered with screen mesh. Continuous spray, timed-sequenced, and headloss monitoring systems optimize water usage for backwashing.

D018
WET AIR OXIDATION WORKS IN LOUISVILLE, KY.,

Water and Wastes Engineering, Vol. 14, No. 9, p 54, September, 1977.

Four 250-gpm sludge oxidation units have been installed at the Morris Forman waste water treatment plant in Louisville, Kentucky. Tests conducted at Zimpro, Inc., in Rothschild, Wisconsin, for the EPA and Louisville Metropolitan Sewer District officials showed that low pressure wet air oxidation was capable of reducing concentrations of hexachlorocyclopentadiene and octachlorocyclopentadiene by 93%. Dewatering and incineration of the oxidized sludge in a multiple hearth furnace substantially reduced concentrations of hexachlorobenzene, another toxic chemical. Results of the studies were verified with 3500 gal of sludge shipped to Zimpro. Temperature, pressure, and aeration conditions employed in wet air oxidation destroy the two pentadienes in the first stage of treatment. A vacuum filter is then used to dewater the oxidized sludge to a solids content of 40%. Analyses of ash and stack gas produced during incineration of the dewatered sludge indicated that all three toxic chemicals were effectively destroyed during the processes.

D019
CENTRIFUGES CONCENTRATE SLUDGES,

Public Works, Vol. 108, No. 10, p. 110, October, 1977.

The United Sewerage Agency has installed three Dorr-Oliver Merco centrifuges at its waste water treatment facilities in Durham, Oregon. The centrifuges are used to thicken waste activated sludge and lime sludge. Centrifuge-thickened waste activated sludge and gravity-thickened primary sludge are combined prior to heat treating, dewatering, and incineration. The lime sludge which contains about 80% calcium carbonate is thickened before it is recalcined for recovery of the lime for reuse in the treatment process. In the operation of the disc-nozzle centrifuges, sludge enters the feedwell of a high speed rotor and passes to the impeller where it is brought up to rotor speed. Heavier particles are discharged to the underflow collector through nozzles at the periphery of the rotor. Clarified liquid travels up through the unit and is collected through an overflow discharge.

D020
NEW DEVELOPMENTS IN FILTRATION,

Fox, G. T., and Lekkas, T. D.

Imperial College,
London, England,
Department of Public Health Engineering.

Water Services, Vol. 81, No. 978, p 460, 462, August, 1977. 1 fig.

Recent research on the dynamics of rapid sand filtration is described. Studies were initiated to develop filtration technology which would allow waste water facilities to eliminate sedimentation before filtration. In order to provide efficient filtration, sand grains in the filter must be arranged so that larger particles are positioned at the top of the filter to remove large debris and smaller particles are at the bottom of the filter to remove smaller debris. However, when the filter bed is fluidized in operation, smaller grains migrate to the top and the efficiency of the filter is reduced. The mechanics of size grading in a sand filter are described and related to surface friction and particle size. Upflow filtration was developed to eliminate problems associated with gravity settling of larger particles. The multilayer filter, containing anthracite/sand in a two-layer filter and polystyrene/anthracite/sand in a three-layer filter, incorporates the use of larger media which have a lower specific gravity than the smaller media. Head loss profiles are compared for the two types of filters. Proper orientations of the media in a multi-layer filter are maintained because of the density differences. Although more costly than sand filters, multi-layer filters can run up to 10 times longer than rapid sand filters. Research on the use of flexible plastic baffles or plastic sponge mesh for filtration is described.

D021
SYSTEM CONTROLS TREATMENT PLANT,

Instrumentation Technology, Vol. 24, No. 6, p 21, June, 1977.

The Franklin, Ohio, waste water treatment plant of the Miami Conservancy District has incorporated a digital control system into its facilities. Two MODCOMP computers produced by Systems Control Inc. of Palo Alto, California, are used to monitor pH, chlorine residual, dissolved oxygen, mixed liquor suspended solids, and primary sludge density. One of the computers is located at the Franklin plant to handle on-site control and monitoring while the second is located at headquarters in Dayton to coordinate operations of up to eight treatment plants. The Franklin plant, with a design capacity of 4.5 mgd and an average loading capacity of 3 mgd, treats combined municipal and industrial wastes for a population equivalent of 200,000. The average daily loading of COD ranges from 70,000 to 100,000 lbs/day. Storing industrial wastes, primarily from four paper mills, the Franklin solid waste recovery plant, and a liquid industrial waste recycling system, are separated from municipal wastes during primary treatment.

D022
PROCESS DESIGN MANUAL FOR UPGRADING EXISTING WASTEWATER TREATMENT PLANTS,

1974. 358 p, 78 fig, 105 tab, 360 ref, 2 append. Technical Report EPA-625/1-71/004a.

Procedures to upgrade existing waste water treatment plants in order to meet more stringent treatment requirements, increase hydraulic and/or organic loading capacity, or improve poor performance due to improper plant design and/or operation are examined by Metcalf and Eddy, Inc., of Boston, Massachusetts. Investigative approaches for the identification of problem areas and the establishment of plant requirements are presented. Aspects of flow equalization which are discussed include benefits of dry weather equalization, determination of equalization requirements, costs, performance, and case histories. Considerations in upgrading trickling filter plants are examined. Techniques for upgrading activated sludge plants are described. Advantages and process design are discussed for clarification and chemical treatment. Effluent polishing techniques which are discussed include polishing lagoons, microscreening, filtration, and activated carbon adsorption. Preaeration and postaeration practices, disinfection methods, and odor control are examined. Sludge thickening methods are evaluated, including gravity thickening, air flotation, and centrifugation. Sludge stabilization methods using anaerobic digestion, aerobic digestion, heat treatment, or lime addition are evaluated. Methods of sludge dewatering which are described include vacuum filtration, drying beds, centrifugation, and filter presses. Nine case histories of treatment plant upgrading are described.

D023
RETIRED MAYOR SPARKPLUGS SEWAGE TREATMENT CHANGE,

The American City and County, Vol. 92, No. 9, p 77, September, 1977.

The city of Winter Haven, Florida, has begun using spray irrigation for tertiary waste water treatment and waste water disposal. A central-pivot spray system developed by Valmont Industries of Valley, Nebraska, is being used to apply treated effluent to 1500 acres of city-owned farmland. The treated effluent is used to fertilize chop feed crops with yields of 70 tons/acre/yr. The crops are expected to remove 475-500 lbs nitrogen/acre/yr from the effluent. Possible contamination from waste water irrigation is monitored by 36 wells at depths of 10-120 ft. Spray irrigation replaces discharge of treated effluent into the city's lake system by the 2.75-mgd South plant and the 1.7-mgd North plant. Two new 5.0-mgd facilities, one in operation and one in the planning stage, will eventually replace existing facilities. Irrigation is accomplished by spray arms which are supported on triangular carriages.

D024

STUDIES ON NITROGEN REMOVAL IN SEWAGE TREATMENT PLANTS (Gesuishori shisetsu ni okeru chissojokyo ni kansuru kenkyu),

Saito, K., Kobori, K., Ochi, S., and Yagihashi, I.

Kankocho Kogai Senmon Shiryo, Vol. 12, No. 3, p 49-61, 1977. 21 fig, 6 tab, 8 ref.

Laboratory and field investigations examined the operating conditions for nitrification in the activated sludge process, defined operating parameters for effective nitrification and organic removal with existing treatment facilities, and evaluated recovery of organic carbon from anaerobic digester supernatant for use in denitrification. Laboratory-scale plug flow aerators were used to examine the effects of pH on nitrification with different substrates. The effects of salinity on nitrifying bacteria were examined at activated sludge plants. Field studies were conducted to examine seasonal variations of nitrifiers and to evaluate general performance of sewage treatment plants in Japan. The studies indicated that the optimum operating parameters for nitrification were a pH of 7-9 and an SRT of more than 10 days. Organic loadings less than 0.24 kg BOD/kg SS/day did not affect nitrification. The addition of alkalinity was necessary to oxidize TKN completely to nitrite or nitrate nitrogen. Growth of fresh water nitrifiers was inhibited under conditions of more than 40% seawater and was maximum when no seawater was added. With combined cultures of freshwater and seawater nitrifiers, maximum growth was observed with a total seawater media. It was suggested that seawater acted as a buffering agent. Field studies on Japanese sewage treatment plants indicated that nitrifiers were present at an average concentration of 1000-10,000 N/ml with Nitrobacter being more abundant than Nitrosomonas. Effective nitrification was observed at temperatures of 18-23 C and at dissolved oxygen levels greater than 28% of saturation.

D025
EFFECTS OF SEVERAL OPERATIONAL PARAMETERS ON THE REMOVAL EFFICIENCY OF THE TOWER-TYPE PACKED BIOFILTER (Juten toshikiro sho ho ni okeru sekkei, unten parameta no joka koritsu ni oyobosu eikyo),

Yoshihara, K., Sambuichi, M., Fujio, Y., and Ueda, S.

Kyushu University, Fukuoka, Japan,
Department of Food Science and Technology.

Hakko Kogaku, Vol. 55, No. 3, p 122-128, 1977. 8 fig, 1 tab, 25 ref.

The tower-type packed biofilter, a modified trickling filter filled with small rounded stones, was evaluated for COD removal in the treatment of organic waste water. The 1.5-m high biofilter was used to treat synthetic waste water which contained 0.17 kg COD/cu m/day. Waste water was recirculated through the filter at a rate of 600 ml/min to insure adequate maintenance of the biological film on the filter media. The tower-type filter was capable of removing 1.2-1.4 kg COD/cu m/day. Factors affecting COD removal efficiency for the tower-type filter were quantitatively similar to those affecting conventional trickling filters, including hydraulic loading, organic loading, filter depth, and forced ventilation of some gases. COD removal was inadequate at high hydraulic loading rates (36 cu m/sq m/day). Odor problems, attributed to inadequate aeration by natural-draft ventilation during the use of the filter, were alleviated when air or oxygen was supplied to the biofilter at 90 cu m/sq m/day. COD removal was not influenced by the dissolved oxygen concentration in the filter.

D026
LAB TO TEST BULRUSHES AS FILTERS FOR SEWAGE,

Water and Wastes Engineering, Vol. 14, No. 9, p 16, September, 1977.

Environmental Quality Laboratory, Inc., a subsidiary of General Development Corporation, is investigating the use of bulrushes to create a low-cost, natural means of tertiary sewage treatment. In experiments at Port Charlotte, Florida, 6" bulrush plants were planted in plastic-lined troughs which were filled with water to create a half-acre artificial marsh. A 12-month testing program is being used to evaluate phosphorus and nitrogen removal from primary and secondary treated effluents by bulrushes in the waste water flooded artificial marsh. Since advanced waste water treatment is required for the future, the marshland filtration system may provide tertiary treatment at lower construction and maintenance costs than conventional systems would.

D041
WHY NOT INCINERATE YOUR SCREENINGS?,

Aldridge, A. P., and Day, D. C.

Water Services, Vol. 81, No. 978, p 486-488, August, 1977. 1 tab.

Screenings at a sewage treatment plant are normally pulverized to a pumpable size or removed completely by screens before sewage enters the main treatment system. Conventional methods of screenings disposal include on-site landfills, on-site sludge incineration, private hauling, local refuse dumping, and local refuse incineration. The use of specially designed, on-site sludge incinerators is suggested as the most cost-effective, least objectionable method of screenings disposal. The Nichols Screenings Incinerator has a positive raking system to insure constant agitation of the screenings and a specially designed combustion system. The Nichols incinerator operates autothermally if the screenings are previously dewatered to a water content of approximately 65%, with supplemental fuel required only for incinerator warm-up and periods of low dewatering performance. Automatic controls for start-up and operation regulate the incinerator with monitoring of the temperature and amount of excess air in the combustion chamber. The Nichols incinerator produces a sterile, low volume ash residue which can be collected for disposal at a local dump or discharged to the sewage works for removal with the primary sludge.

D042
A FUTURE FOR AUTOMATIC SLUDGE WITHDRAWAL,

Ching, C. W.

Water Services, Vol. 81, No. 978, p 505-506, August, 1977. 3 fig.

Ham, Baker, and Company Ltd., in conjunction with the Thames Water Authority of England, has produced a system for automatic sludge withdrawal from primary sedimentation tanks. The system can be automatically adjusted to initiate the desludging cycle at a preset time and to terminate sludge removal when the moisture content of the sludge being removed increases to a preset level. Sludge is removed from the sedimentation tank to an adjacent operating chamber. The viscosity of the sludge controls the velocity and level at which the sludge enters the operating chamber. Since the level in the control chamber will be related to the sludge moisture content, the inlet valve can be readily adjusted to close at a predetermined level. The automatic system eliminates the need for manual control and operator decisions.

D043
FLOW EQUALIZATION IS ON THE LEVEL,

Foess, G. W., Meenahan, J. G., and Harju, J. M.

Johnson and Anderson, Incorporated,
Pontiac, Michigan.

Water and Wastes Engineering, Vol. 14, No. 9, p 96, 98, 100, 105-107, 134-135, September, 1977. 1 fig, 1 tab.

Flow equalization as a means of leveling influent flow and concentration variations was evaluated at the 2.1-mgd Walled Lake/Novi waste water treatment plant in Michigan. Treatment at the tertiary facility uses the activated sludge process followed by multi-media tertiary filtration. Parameters measured during the 12-month evaluation period included BOD, total suspended solids, and total phosphorus under conditions of equalized and non-equalized flow. Influent waste water, primarily of domestic origin, is bar screened and then pumped from a wet well to the plant. The equalization basin used in the study received raw water from the wet well. During periods of low flow, the waste water flowed by gravity back to the wet well and an automatic valve controlled the discharge from the equalization basin. Further treatment at the plant included grit removal, aeration, final settling, chlorination, filtration, chemical treatment, and aerobic digestion. Design data for the facility are presented. The equalization basin at Walled Lake/Novi is a 337,000-gal basin provided with a sludge scraping mechanism and aeration equipment for an air input of 2 cfm of air per 1000 gal of storage. Operation of the plant under flow-equalized conditions resulted in higher total suspended solids levels in secondary clarifier effluent, but effluent quality was better with respect to the other parameters than under non-equalized flow conditions.

D044
INNOVATION IN STORM WATER MANAGEMENT,

Civil Engineering-ASCE, Vol. 47, No. 7, p 20, September, 1977.

In construction of additional parking facilities at the Alexandria Hospital, the city of Alexandria, Virginia, also required construction of storm water detention facilities to alleviate runoff problems. The VVKR Partnership of Alexandria was contracted by the hospital to design storage facilities. Calculations indicated that a storage volume of 6000 sq ft would be necessary for the 5-acre site. Conventional methods of storm water detention used in the Washington metropolitan area include surface storage ponds and below-grade storage in concrete chambers, over-sized pipes, or gravel interceptors. These methods were rejected for the site because of costs, maintenance requirements, and the site topography. A fiberglass tank system was chosen because of its lower costs and construction requirements. Provided by Owens-Corning Fiberglass, the 75-ft diameter tank was shipped in two sections and installed by the Arlington Asphalt Company of Arlington, Virginia.

D045
APPLICATION OF SEWAGE SLUDGE TO CROPLAND: APPRAISAL OF POTENTIAL HAZARDS OF THE HEAVY METALS TO PLANTS AND ANIMALS,

1976. 69 p, 23 tab, 87 ref, 1 append. Technical Report EPA 430/9-76-013.

A state-of-the-art survey on the potential effects of heavy metals in land-applied sewage sludges on agricultural crops, animals, and groundwater is presented. Quantitative and qualitative data are given for sludge production, cropland requirements, and the metal content of crops. Limiting factors on the application of municipal sludges to cropland are examined, including the rate of application, nitrogen content, heavy metal concentrations, phosphorus, boron, and soluble salts. Accessory criteria are described, including soil properties, reclamation of disturbed lands, groundwater protection, surface water protection, crop selection, and monitoring needs. Aspects of monitoring which are considered include sampling methods, sample preservation, and analytical procedures. Heavy metals and other elements which may be present in sewage sludge but do not pose a significant hazard to plants and animals are examined, including: manganese, iron, aluminum, chromium, arsenic, selenic, antimony, lead, and mercury. Elements which pose a potentially serious hazard because of their toxicities or concentrations include cadmium, copper, molybdenum, nickel, and zinc.

D046
ADVANCED TECHNIQUES FOR INCINERATION OF MUNICIPAL SOLID WASTES,

DeMarco, J.

Environmental Protection Agency,
Washington, District of Columbia,
Office of Solid Waste Management Programs.

1972. 15 p, 3 fig. Technical Report EPA-SW-38d.

A three-phase pyrolysis project in New York State is described. Sponsored by Erie County, New York, Torrax Corporation, Carborundum Company, A. E. Anderson Construction Corporation, America Gas Association, and other state and federal agencies, the project was designed to demonstrate the use of a 75-tpd pyrolysis system to convert municipal waste into an inert residue. Major subsystem components were designed, installed, and operated as a part of the first phase. System testing and installation of the remaining equipment for exhaust control comprised the second phase. Economic and technical data will be gathered during 24-hr operation of the system during the third phase. Major subsystems in the system include a super blast heater, a gasifier, a secondary combustion chamber, a gas cooler, and an air pollution control device.

D047
EVALUATION OF SEWAGE TREATMENT FACILITIES, SAN FRANCISCO, CALIFORNIA, SEPTEMBER 1975,

1975. 135 p, 18 fig, 28 tab, 13 ref, 3 append. Technical Report EPA-330/2-75-008.

Sewage treatment facilities in San Francisco, California, were evaluated in 1975 to determine discharge limitations of the North Point, Richmond-Sunset, and Southeast waste water treatment plants. Additional objectives were to determine whether waste discharges posed hazards to San Francisco Bay and the Pacific Ocean, and to evaluate interim water pollution control measures. The studies included in-plant and receiving-water surveys at each of the facilities. Design data for each of the three facilities is presented. Physical-chemical characteristics, bacteriological characteristics, and toxicity response of the threespine stickleback were measured for plant effluent and receiving waters. Operation and efficiency of each plant was examined. Studies were conducted at outfall locations to determine the effect of effluents on oyster survival and propagation and to examine benthic conditions. Appendices to the report include presentations of survey results, methods used in the survey, and chain of custody procedures.

D048
HIGH-PRESSURE, THIN-CAKE, STAGED FILTRATION,

Bagdasarian, A., Tiller, F. M., and Donovan, J.

Artisan Industries,
Waltham, Massachusetts.

Filtration and Separation, Vol. 14, No. 5, p 455-458, 460, September-October, 1977. 8 fig, 16 ref.

Continuous, high pressure, thin-cake, staged filtration can be used in the post-treatment phase to dewater sludge. Alternate rotating and stationary filter elements are included in staged filters with rotating turbines. Sludge cake formation is inhibited by an induced drag on the stationary elements while the slurry is dewatered. Torque on the rotating turbine shaft during the last stage of filtration produces a shearing action which maintains the fluidity of the filtered solids. The final cake is continuously extruded. Higher filtration rates and lower porosities (higher sludge solids content) are produced with continuous staged filtration than with conventional pressure or vacuum filtration. The mechanism of thin cake filtration, the effects of flow rate per unit area, and washing methods are described.

D049

COST-EFFECTIVE COMPARISON OF LAND APPLICATION AND ADVANCED WASTEWATER TREATMENT,

Pound, C. E., Crites, R. W., and Smith, R. G.

1975. 25 p, 4 fig, 13 tab, 4 ref. Technical Report EPA-430/9-75-016.

Land application system costs were compared with those of advanced waste water treatment systems, and the cost sensitivities of design variations in land application systems were examined. Four advanced treatment systems were developed: a system designed to remove NH_3-N, one designed to remove total N, one designed to remove phosphorus and suspended solids, and one designed to remove total N, P, and suspended solids. Quality of effluents produced by these four systems is compared to that produced by aerated lagoon, activated sludge, irrigation, overland flow, and infiltration-percolation treatment processes. Cost bases and implications are given for overall costs, variable site conditions, land price, federal and local share of total present worth costs, and components. Two hypothetical situations are presented to illustrate the use of comparative cost curves and cost tables in treatment method and design choice.

D050

CHEMICAL ASPECTS OF GROUND WATER RECHARGE WITH WASTEWATERS,

Russell, L. L.

Dissertation Abstracts International B, Vol. 38, No. 2, p 862, August, 1977.

Studies on waste water-soil systems and recharge water quality indicated that nitrification in the soil rather than in a waste water treatment plant could substantially reduce percolant water quality. This was attributed to low carbon dioxide concentrations in aerated effluents which could also dissolve calcareous soils, resulting in high calcium concentrations of up to 200 mg/liter. Field studies at the 14-mgd Whittier Narrows Water Reclamation Plant and the 26-mgd San Jose Creek Water Renovation Plant indicated that 90-95% of the CO_2 produced during treatment was stripped during aeration. A systematic, mathematical model for the chemistry of a waste water-soil system is presented. The effects of minor buffering systems, complex ion formation, temperature, and ionic strength are incorporated into the model. The model is useful in simulating the effects of waste water treatment on effluent quality and the effects of land application on percolant quality, mixing, dilution, and subsequent chemical reactions during percolation.

D051
WASTEWATER REUSE BY THE TRUCKLOAD,

The American City and County, Vol. 92, No. 9, p 40, September, 1977.

The East Bay Municipal Utility District (EBMUD) of Oakland, California, has implemented a waste water reclamation project in an effort to preserve existing water supplies. Secondary treated waste water is trucked to approved customers and designated for limited use in non-residential irrigation, sewer flushing, compaction of building sites, and dust control at landfills. Waste water reclamation is currently being practiced by the San Pablo Sanitary District, Central Contra Costa Sanitary District, Ora Loma Sanitary District, and the city of San Leandro. Costs for transportation, administration, and construction will eventually be apportioned to users. Initial costs to install pumps, hook up lines or hoses to the effluent pond, and discharge effluent to trucks are $2000-3000. Current costs for reclaimed waste water are about $20/1000 gal, as compared to $0.50/1000 gal for water from conventional sources.

D052
DESIGNING TO REMOVE PHOSPHORUS BY USING METAL SALTS AND POLYMERS IN CONVENTIONAL PLANTS,

Laughlin, J. E.

Shimek, Roming, Jacobs, and Finklea,
Dallas, Texas.

1971. 12 fig, 35 ref. NTIS Technical Report PB-256 376.

A report on treatment design to remove phosphorus from waste water was presented as part of the EPA-sponsored "Design Seminar for Wastewater Treatment Facilities" which was held in Seattle, Washington, on December 1-2, 1971. Metal salts and polymers used in conventional waste water treatment plants, including $FeCl_3$, pickle liquor, alum, and sodium aluminate, are evaluated. Topics discussed include: phosphorus removal needs, process variations, pilot studies, chemicals, hardware, dosage selection and control, polymers, coagulants, sludge harvesting and disposal, supernatant characteristics, and costs. Flash mixing, flocculation, chemical injection, feeding equipment, piping, and storage tanks are discussed with respect to design data, use, and efficiency. Chemical and capital investment costs are presented.

for Salmonella varied for the three plants, with the plant at Bunschoten-Spakenburg having the highest reduction (2.22 logs). The reductions in E. coli, coliforms, and fecal coliforms at the three plants were similar, and were dependent on the total residual chlorine content of the effluent. MPN's of E. coli, coliforms, and fecal streptococci in effluent before and after chlorination are presented for the three facilities.

D068

BATCH AEROBIC TREATMENT OF A COLLOIDAL WASTEWATER,

Khararjian, H. A., and Sherrard, J. H.

Worcester Polytechnic Institute,
Massachusetts,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 9, p 1985-1992, September, 1977. 6 fig, 2 tab, 9 ref.

Treatment with contact stabilization, a modification of the activated sludge process, is normally indicated for waste water containing a large percentage of colloidal organic matter. Since the percentage of colloids may indicate that contact stabilization processes are necessary for a given facility, studies were conducted to determine whether there was a substantial release of substrate after an initial rapid uptake. Batch experiments were used to examine the biodegradation of waste water as a function of its percentage of colloidal material, based on a test for chemical oxygen demand. Colloid concentrations of 0, 23, 43 and 54% were prepared by adding beef extract and yogurt to synthetic sludge. Initial loading conditions were 0.158-1.083 mg/liter COD per mg/liter MLSS. Samples collected at various time intervals were analyzed for COD, MLSS, and oxygen uptake. No immediate uptake and substantial organic material were noted with concentrations under 54%. Biodegradation was similar to that of the soluble substrate.

D069

THE OHIO FARM BUREAU'S APPROACH TO LAND APPLICATION OF SEWAGE SLUDGE,

Musselman, N. M.

Compost Science, Vol. 18, No. 4, p 24-25, July-August, 1977.

Opinions of the Ohio Farm Bureau Federation on practices involving the land application of sewage sludge as a means of sludge disposal and soil conditioning are presented. A particular incident in which a municipality of approximately 60,000 people sought to create a 1,000-acre sludge farm is discussed. Actions by the Ohio Farm Bureau were directed toward stopping the project in response to pressure applied by a suburb located between the city and the proposed sludge disposal site. General ill feeling on the part of farmers and consumers toward land application of sewage sludge is a major stumbling block to this category of waste disposal. The Ohio Farm Bureau has not chosen to endorse the concept totally, in light of potential problems associated with sewage bacteria and pathogens, the question of liability should any incident occur, and objections by its constituents.

D070

WOONSOCKET, RHODE ISLAND SEEKS SOLUTION TO ALUM SLUDGE DISPOSAL PROBLEM,

Goss, J.

Metcalf and Eddy, Incorporated, Consulting Engineers,
Boston, Massachusetts.

Journal of the New England Water Works Association, Vol. 30, No. 3, p 191-198, September, 1976. 4 fig.

Metcalf and Eddy, Inc., of Boston, Massachusetts, was contracted by the city of Woonsocket, Rhode Island, to design a method of disposal for the alum sludge produced by the 11.25-mgd Woonsocket water treatment plant. Previously, settled sludge from the upflow clarifiers (4,600 mg/liter suspended solids) and spent water used to backwash the filters (170 mg/liter suspended solids) had been discharged directly to the Blackstone River. One of the problems encountered in design of a disposal method was that the wastes, in the form of a small volume of concentrated waste and a large volume of dilute waste, were produced intermittently and for very short periods. The wastes also had markedly different settling characteristics. An equalization tank to hold the clarifier sludge flow and the settled sludge from a filter backwash water presettling basin was chosen to even out waste concentrations and flow. Variable physical and mechanical processes, including lagooning, sand bed drying, freezing, centrifugation, vacuum filtration, and pressure filtration, were evaluated with respect to producing a sludge cake with 20% or more solids suitable for land disposal. Climatological considerations, land requirements and other factors led to the choice of construction of facilities to discharge the sludge to Woonsocket's sewage treatment plant for treatment and disposal. A schematic diagram of the recommended $1.61 million alum sludge disposal facility is presented.

D071
DALLAS PAYS THE PRICE OF CLEANER EFFLUENT,

Rice, I. M., and Mauck, C. A.

Dallas Water Utilities,
Dallas, Texas.

Water and Wastes Engineering, Vol. 14, No. 9, p 42-45, September, 1977.

The 1-mgd Dallas Wastewater Reclamation Research Center was constructed to provide design data for an advanced waste water treatment plant needed by the city of Dallas. Data obtained during the first year of operation of the Research Center indicated that treatment with the completely-mixed activated sludge process, followed by filtration before discharge into the Trinity River, was probably the most economical and efficient method of treatment for the proposed expanded facilities at the Dallas Central Wastewater Treatment Plant. In the expansion of the Central plant from a capacity of 100 mgd with secondary treatment to a capacity of 150 mgd with tertiary treatment, the addition of the completely-mixed activated sludge process followed by mixed media filters resulted in an effluent with less than 10 mg/liter BOD and 10 mg/liter total suspended solids. A 180-mgd capacity pumping station pumps effluent from the secondary treatment facility to a series of splitter boxes which divert the flow to 12 aeration basins. Each 70 x 70 x 26-ft aeration basin is equipped with four 75-hp mechanical surface aerators. Twelve associated sedimentation basins which remove the suspended solids are equipped with scum and sludge removal equipment. A 4.5-million-gal aerobic digester treats waste activated sludge and scum from the sedimentation basins. An emergency settling basin was constructed to provide 5 hrs of additional settling time under high flow conditions. Chemically treated effluent is filtered with 14 mixed media filters before discharge to the Trinity River at the White Rock pump station.

D072
FOREWORD OZONE SYMPOSIUM,

Tao, J. C., and McDowell, C. S.

Air Products and Chemicals, Incorporated,
Allentown, Pennsylvania.

AIChE Symposium Series, Vol. 73, No. 166, p 186-187, 1977. 10 ref.

Various aspects of the use of ozone for disinfection of municipal and industrial waste water are discussed. The possible toxicity and carcinogenicity of compounds produced during chlorination have led to research into alternative means of disinfection. Studies on chemical reactions occurring between waste water constituents and ozone and on the environmental effects of ozonated effluents are described. The effects of pH, temperature, and the presence of ammonia in the waste water on ozone disinfection efficiency are discussed.

The use of ultraviolet light or ultrasound in conjunction with ozone to degrade organic materials is described for waste waters which contain particularly toxic or resistant substances. Design criteria, cost-effectiveness, and disinfection efficiency requirements which may influence the application of ozone as a disinfectant are discussed.

D073

EFFECT OF SEWAGE TREATMENT BY STABILIZATION POND METHOD ON THE SURVIVAL OF INTESTINAL PARASITES,

Veerannan, K. M.

Water Analysis Department,
King Institute,
Guindy, Madras, India.

Indian Journal of Environmental Health, Vol. 19, No. 2, p 100-106, April, 1977. 1 tab, 24 ref.

The survival of pathogenic intestinal parasitic protozoans and helminths in sewage stabilization ponds was evaluated in a sampling program at three stabilization pond sites near Madras, India. Each pond held waste water from a different source: a tuberculosis sanatorium, the Indian Institute of Technology, and the Kodungaiyur sewage farm. Composite samples of sewage before and after treatment were collected bi-weekly throughout the study. Concentrations of Entamoeba coli, Entamoeba histolytica, Giardia lambia, Ascaris lumbricoides, and Enterobius vermicularis were measured in samples of pond influent and effluent. The study results indicated that the concentration of protozoan cysts and ova varied up to 844/liter and that removal efficiencies ranged from 38.5% at the Indian Institute of Technology to 100% at the sanitorium. A comparison of relative removal efficiencies for various organisms indicated the stabilization pond at the sanitorium in Tambaram was more efficient at removing protozoan cysts, while the pond at Kodungaiyur was more efficient at removing helminthic ova.

D074
PROCESS ARRANGEMENTS FOR ION EXCHANGE AND ADSORPTION,

Vermuelen, T.

California University,
Berkeley,
Department of Chemical Engineering.

Chemical Engineering Progress, Vol. 73, No. 10, p 57-61, October, 1977. 7 fig, 5 ref.

The use of various resin types and process arrangements can maximize performance and minimize operating costs of ion exchange and adsorption in water and waste water treatment. The use of ion retardation materials, ion-exclusion agents, electron-exchange resins, and polymeric resin membranes to enhance ion exchange processes is discussed. Several process arrangements are described, including large-scale "swimming-pool" systems for water treatment, mixed bed deionization, cyclic multi-bed systems, continuous ion exchange, reverse-flow regeneration, combination fixed-bed and fluidized-bed systems for water softening, and the Sirotherm or thermal-cycling process for desalination. Schematic flow diagrams are provided for each of the process configurations.

D075
JET FLUID GAS/LIQUID CONTACTING AND MIXING,

Mandt, M. G., and Bathija, P. R.

Penberthy Division,
Houdaille Industries, Incorporated,
Cedar Falls, Iowa.

AIChE Symposium Series, Vol. 73, No. 167, p 15-22, 1977. 9 fig, 8 ref.

The use of jet gas/liquid contactors in tank mixing systems to enhance the gas-liquid interface was investigated in a testing program with the Eddy Mix Jet System. The system consists of a series of gas jets mounted in a radial pattern or cluster on the unit. A plume in which small bubbles have been entrained is injected into the mixing tank. The plume momentum produces eddy currents which force tank turnover and increase mass transfer. The Eddy Mix Jet System was evaluated in a testing facility equipped with 12-, 30-, and 55-ft diameter tanks. Flow velocity was measured at various jet submergence depths and air flow rates. A series of equations to describe flow characteristics in the basin with respect to basin design, jet position, and operating parameters are presented. An example in which the expected turn time, total pumpage, and average velocity are calculated is presented for a 50-ft dia basin with a 22-ft side water depth and a 12-jet cluster. The directional mix jet system in which jet gas/liquid contactors are arranged longitudinally along the axis of a closed loop flow channel is described. A series of equations to estimate channel velocity at given operating parameters and design data is presented. A method for calculating the total loss coefficient is presented.

D076
EPA RELAXES ITS STANDARDS ON SEWAGE SETTLING PONDS,

Engineering News-Record, Vol. 199, No. 16, p 15, October, 1977.

Since compliance with secondary waste water treatment standards set by the 1972 Federal Water Pollution Act may require small communities to build elaborate sewage treatment plants and abandon existing settling ponds, the EPA has modified its effluent quality standards. Under the new regulations, communities which meet the BOD standard of 30 ppm over a 30-day average will not be required to comply with the equally strict standard for suspended solids. The relaxed standards will be adjusted to accomodate variations in climate and geography. Lagoon treatment of sewage or decomposition in an artificial pond exposed to air and sunlight is considered by the EPA as a viable alternative to more expensive means of secondary treatment.

D077
THE PROMISES OF ION EXCHANGE,

Helfferich, F. G.

Shell Development Company,
Houston, Texas.

Chemical Engineering Progress, Vol. 73, No. 10, p 53-55, October, 1977.

The historical background and development of ion exchange technology are described. Prior to 1935, most of the interest in ion exchange was directed toward developing a theory to explain the process. From 1935 into the 1950s research was directed toward developing ion exchange materials, leading to the introduction of more stable styrene polymers and the strong base anion exchange resins. Around 1955 commercial ion exchange membranes were introduced and the separation technique of ligand exchange was developed. Developments led to practical applications of ion exchange technology with emphasis on water treatment. Theoretical studies examined alkali metal equilibria on strong acid ion exchangers. Current research emphasizes conservation of the environment, energy, and raw materials. The need for research into the use of ion exchange in situations where other physical phenomena such as adsorption, ionic association, neutralization, or complex formation complicate treatment processes is emphasized.

sludge inlet and clarified water drain are located along the full length of the gas bubble-producing electrode apparatus. Anodes and cathodes are superimposed on the bottom of the cone-shaped container. The anodes form a grid with the cathode plate placed beneath them. Sludge is passed along the entire length of this arrangement to bring about electrolytic flocculation. The process is especially effective in activated sludge treatment.

C041

PURIFICATION AND CLARIFICATION OF SEWAGE--USING A FINELY DIVIDED COAGULATION-ADSORPTION MATERIAL HAVING A THIN HYDROXYLATED SURFACE,

Netherlands Patent NL 7704-854. Issued November 7, 1977. Derwent Netherlands Patents Report, Vol. Y, No. 47, p 6, January, 1978.

A patent has been issued for a waste water treatment process which involves the use of a coagulating-adsorbing agent for clarification. Suspended solids, colored matter, and microorganisms are removed by the addition of a finely divided material which has the capacity for both coagulation and adsorption. The material has a thin hydroxylated layer which is derived from the finely divided material or from other materials. This coagulating and adsorbing material has individual particles with thin hydroxylated surfaces having positive zeta potentials. The zeta potential is determined by pH absorption. The coagulating agent with a hydroxylated layer in the form of finely divided material is preferably derived from oxides or silicates.

C042

PLANT FOR ACTIVATED SLUDGE TREATMENT OF EFFLUENT--OF COMPACT DESIGN AND CONSTRUCTION,

Belgian Patent BE 855-140, Issued November 28, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 48, p 3-4, January, 1978.

A compact plant for the treatment of waste water by the activated sludge process has been patented. Screening of large solids from the effluent is conducted in an excavated earthen basin formed by a dam. The resulting solids are pulverized with a comminuting pump. The waste water is aerated and stirred in a circular motion by gas jets in the aeration basin. Waste material is constantly removed from the center of the basin. A channel runs horizontally from the top of the aerator to a distributor in the center of the settling basin. A scraper continuously removes sludge from the settling basin. The sludge is stored in a lagoon. One side of the unit corresponds in length to the largest dimension of the largest piece of equipment. The parallel remaining side is equal in length to the summation of the smallest dimension of the largest unit and the largest dimension of another unit.

C043

TREATING WASTE WATER, ESP. FROM CESS PITS, WITH FLOCCULANTS--THEN GRAVITY FILTRATION THROUGH TEXTILE TO REDUCE SOLIDS AND BOD,

Belgian Patent BE 854-634. Issued November 14, 1977. Derwent Belgian Patents Abstracts, Vol. Y, No. 47, p 2, January, 1978.

A waste water treatment process utilizing flocculation followed by filtration through a support material has been patented. Flocculants are applied to the effluent in the first stage of treatment. The waste water is then passed through a gravity filter for the removal of suspended solids. The gravity filter consists of an apparatus containing a textile support and the separated solids. The process has proven effective in reducing the BOD and removing up to 20,000 mg/liter of COD from the effluent. The treatment has been shown to be an effective initial separation step in the processing of cesspool and sludge collector effluents. This preliminary separation process is purported to be less expensive, more adaptable, and less time consuming than conventional separation techniques.

C044

BAFFLE FOR WATER OR SEWAGE SETTLING TANKS,

McGivern, R. F.

Sybron Corporation,
Rochester, New York. (assignee)

United States Patent 4,059,529. Issued November 22, 1977. Official Gazette of the United States Patent Office, Vol. 964, No. 4, p 1266, November, 1977. 1 fig.

A baffle unit for waste water or sewage settling tanks has been patented. The baffle consists of an upright panel with a spacer extension installed on the wall of the settling tank where the waste inlet is located. One or more deflectors, affixed to the upright panel below the spacer, extend out from the panel toward the spacer. The deflector or deflectors direct the flow of waste upwards in the direction of the spacer. The upright panel is solid between the spacer and the deflector. Below the deflector, the upright panel contains a series of horizontal and vertical openings which allow the waste liquid to flow through the upright panel for settling treatment.

D078
SOLID-LIQUID SEPARATION: AN OVERVIEW,

Tiller, F. M., and Crump, J. R.

Houston University,
Texas,
Department of Chemical Engineering.

Chemical Engineering Progress, Vol. 73, No. 10, p 65-75, October, 1977. 14 fig, 2 tab, 15 ref.

Solid-liquid separation techniques have been used in a wide variety of situations, including mining, waste, and water treatment operations. Solids separation involves pretreatment to increase particle size, thickening, clarification, filtration, centrifugation, and post-treatment to remove soluble materials and reduce average porosity. Product specifications in terms of filtrate clarity, permissible solubles content of the cake, and average porosity or liquor content of the cake are discussed as criteria for equipment selection. Pretreatment methods used in solid-liquid separation include chemical pretreatment to enhance flocculation or coagulation; pH control; surface charge neutralization; and physical pretreatment with filter aids such as diatomaceous earth, fly ash, expanded perlite, and other filter aids. Filtration theory related to the flow within the cake and the external conditions imposed upon the cake by pumping and by filter design are discussed. Porosity variation and flow resistance are examined with respect to filtration mechanisms. Mathematical equations for the calculation of resistances and the definition of flow through porous media are presented. Material-balance and rate equations are derived for filtration at constant pressure and rate and at variable pressure and rate. Various techniques for cake washing are described.

D079
UV-OX(TM) PROCESS FOR THE EFFECTIVE REMOVAL OF ORGANICS IN WASTEWATERS,

Zeff, J. D.

Westgate Research Corporation,
Marina del Rey, California.

AIChE Symposium Series, Vol. 73, No. 167, p 206-220, 1977. 8 fig, 5 tab, 7 ref.

The UV-OX(tm) process was developed for the oxidation of dissolved organics, particularly refractory organic compounds in waste water. The process is based on a combined ozonation-irradiation process. The water is agitated at high speed and irradiated by 253.7-nm UV light which is also used to produce ozone. Background information is presented for various methods of decomposition and oxidation, including photochemical decomposition, ozone oxidation, ionic oxidation, free radical oxidation, and ultraviolet-ozone oxidation. Laboratory tests are used to evaluate the system for the degradation of selected organic compounds, including hydroquinone, pyrogallol, xylenol, sodium acetate, and urea. Batch and continuous tests are conducted with a modified reactor and synthetic waste water. The process efficiency was measured in terms of the amount of energy required to completely oxidize each mg of carbon per liter. Process variables which may affect performance include residence time, ozone concentration, ozone mass flow, ultraviolet intensity, and total organic carbon concentration. A simulated, two-stage continuous system was used to determine the maximum total organic carbon efficiency:ozone efficiency with minimum expenditures of ultraviolet energy. The effects of ultraviolet intensity and the reactor diameter were also examined. An evaluation of process scale-up requirements indicated that to treat 100,000 gal/day, 210 reactor units with six 43-watt lamps per unit would be required and daily operating costs would be approximately $72.33.

D080

BIOLOGICALLY ACTIVE FILTER COMBINED WITH ENZYME TREATMENT,

Refaat, M. E.

MicroChem Development Laboratory,
Stockholm, Sweden.

AIChE Symposium Series, Vol. 73, No. 167, p 166-171, 1977. 2 fig, 2 tab, 8 ref.

A waste water treatment process in which anaerobic treatment is improved by the addition of a rapid enzyme-enhanced filter is described. The process is based on the anaerobic fiber bundle filter, a packed bed of individual fibers supported at the top of the filter. The low-weight fiber bundle material can be used in beds up to 120 cm in height without the need for supporting intermediate partitions. In comparison to the conventional stone media used in trickling filters, the fibrous material has a surface area 2-3 times greater, and due to the large free volume can handle high organic loadings. Extracellular enzymes added to the filter act as catalysts during the anaerobic processes. Municipal wastes, waste activated sludge, and waste water from a polyvinyl acetate manufacturing plant were used in an evaluation of the anaerobic filter system. The construction of the filter reactor, fiber pretreatment, enzyme production, operating parameters, cleaning, and analyses of filtrate are described. COD, BOD, and turbidity in the filtrate were used to evaluate filter performance. Tests with the enzyme-anaerobic filter system indicated that flow resistance did not increase during filter operation and that the stabilization capacity of the system was 9.1 g COD/sq m per hr. The addition of extracellular enzymes increased both the BOD and COD removal rates. The BOD in the filter bed decreased with depth and the COD fluctuated, indicating continuous biologic activity through the filter.

D081
DEWATERING MACHINE SOLVES SLUDGE DRYING PROBLEMS,

Eichmann, B. W.

Water Pollution Control Department,
Medford, New Jersey.

Water and Sewage Works, Vol. 124, No. 10, p 99-100, October, 1977. 1 tab.

Medford Township, New Jersey, has installed a belt filter press to dewater aerobically digested sludge resulting from contact stabilization. The waste water treatment plant in Medford includes two 500,000-gpd contact stabilization units to handle a flow of 0.9 mgd. The belt filter press, Flocpress, manufactured by Infilco Degremont Inc. of Richmond, Virginia, is used in addition to an existing coil spring vacuum filter which was left in place for emergency situations. The installation of the Flocpress allowed dewatering of sludge in one shift 3-4 days per week. The belt filter press results in 98% solids capture with a filtrate suspended solids of less than 100 ppm as compared to 1000-2000 ppm produced with the coil filter. Flocpress also requires a smaller dosage and horsepower for operation than the coil filter. In the dewatering process, polymer conditioned sludge is fed to the flocculator and is then spread across a slow-moving, woven synthetic fiber belt. After compression, a flexible scraper or doctor blade removes the sludge from the conveyor belt. Schematic diagrams for the Flocpress sludge dewatering unit and the sludge handling system are presented. An operating log for 1976 is presented for sludge quantities handled, costs, and polymer dosages.

D082
SOLAR ENERGY USED TO CONVERT WASTEWATER TO PROTEIN,

Water and Wastes Engineering, Vol. 14, No. 10, p 37, October, 1977.

Brown and Caldwell has developed a system in which a waste water substrate and solar energy are used to produce a high-quality single cell protein harvested in the form of algae and a usable liquid effluent. Primary treated waste water is subjected to secondary treatment in shallow, high-rate oxidation ponds and the resulting algae is harvested with a device which uses a paper-precoated filter to entrap the dense algae product. In a year-long study in Melbourne, Australia, the initial objective was to use waste paper for the harvester belt fabric; used belts were then recycled as a composite feed for ruminant livestock, the paper providing roughage and energy and the algae providing protein. The algae-laden paper product was reported as having a protein content of 15% by weight. Problems associated with the smaller size of individual algae cells produced in winter and with the high cost of waste paper in Australia led to the development of a two-stage vacuum and rinsing cycle for the separation of algae from pond effluent. In this case a concentrated algae slurry is produced rather than a dried, algae-laden paper. The algae recovery system is recommended for situations where feed supplies are in demand and high-quality sewage treatment is indicated.

D083

RADIATION TREATMENT OF SLUDGE TO BE EXPLORED,

Water and Wastes Engineering, Vol. 14, No. 10, p 50, October, 1977.

The economic and scientific aspects of the use of gamma radiation for disinfection of dried or composted sludge will be investigated in pilot-scale studies at Sandia Laboratories in Albuquerque, New Mexico. Gough and Company, Ltd., of Staffordshire, England, have manufactured the 28,000-lb, 22-ft high irradiation system which is capable of handling several tons of dry sludge daily on a continuous basis. The irradiation facility consists of a conveyor system in which 30-60 lb of sludge is loaded into each of a series of rectangular 10" x 12" x 24" buckets. The sludge-filled buckets are conveyed to a high radiation zone where they receive one megacurie of cesium-137 by passing over and under a gamma radiation source. The system is designed so that the conveyor speed can be adjusted to vary the radiation dosage and so that 20 buckets can occupy the irradiation zone at any given time. The system was developed to use cesium-137, a waste product of nuclear reactors, to disinfect sludge for use as a fertilizer or soil conditioner in the propagation of food crops.

D084

ORE. PLANT WILL MEET REQUIREMENTS,

Water and Wastes Engineering, Vol. 14, No. 10, p 77, October, 1977.

The Corvallis municipal waste water treatment plant in the Willamette Valley in Oregon has been designed by Brown and Caldwell to meet effluent discharge requirements which call for not more than 10 mg/liter of BOD or suspended solids in treated effluents. In the treatment process at Corvallis a diffused-air activated sludge process is designed for operation in three modes: sludge reaeration, stepfeed, and conventional activated sludge. Existing trickling filters were incorporated into the activated sludge system to protect the system from shock loads. The secondary clarifiers are equipped with centerwell flocculators. An alum feed system is provided to insure adequate sludge settling characteristics. Energy requirements were considered in the design of the plant, and a heat recovery coil in the aeration air blower discharge line is used to provide heat in the operation and maintenance building. The plant has a design capacity of 10 mgd, which was created with hydraulic designs allowing the addition of the activated sludge process to increase the design flow rate from 5 to 10 mgd without repumping.

D085

DYE-SENSITIZED PHOTO-OXIDATION--A NEW APPROACH TO THE TREATMENT OF ORGANIC MATTER IN SEWAGE EFFLUENTS,

Acher, A. J., and Rosenthal, I.

Institute of Soils and Water,
Division of Soil Residues Chemistry,
The Volcani Center, Bet Dagan, Israel.

Water Research, Vol. 11, No. 7, p 557-562, 1977. 4 fig, 1 tab, 15 ref.

Sewage treatment with dye-sensitized photo-oxidation may be competitive with other methods of oxidation in climates with a large number of sunlight hours per day. The general mechanism of photo-oxidation by the combined action of visible light and molecular oxygen on organic matter is described. Effluents from circulated oxidation ponds at municipal waste treatment plants in Haifa, Tel Aviv, and Nazareth in Israel were used in experiments on photo-oxidation with rose bengal (RB) and methylene blue (MB) as dye sensitizers. COD, fecal coliform counts, and suspended solids were used to evaluate oxidation efficiency. Initial experiments on the reduction of COD by the exposure of aerated sewage to solar radiation resulted in higher COD reductions with MB. A concentration of MB of 12 mg/liter resulted in the minimum COD values of 120 in sunlight and 112 in ultraviolet radiation. Decreases in removal efficiency above 15 mg MB/liter were attributed to reduced light penetration in the darker medium. Less effective removal below 10 mg MB/liter was attributed to decreases in the dissolved MB concentration by physical adsorption and chemical reactions. Studies on the effect of radiation time indicated that COD levels were constant after 60 min, and that coliforms were completely destroyed after 30 min. MB was successfully removed from treated effluent by adsorption onto bentonite.

D086

MUNICIPAL SLUDGE DISPOSAL ECONOMICS,

Jones, J. L., Bomberger, D. C., Jr., Lewis, F. M., and Jacknow, J.

SRI International,
Menlo Park, California.

Environmental Science and Technology, Vol. 11, No. 10, p 968-972, October, 1977. 1 fig, 4 tab.

Capital, operating, and energy costs are compared for five sludge handling alternatives. The options for treatment and disposal include: vacuum filtration of sludge to 20% solids, or filter press dewatering of sludge to 40% solids, prior to incineration; thermal conditioning, vacuum filtration, and incineration; high-pressure wet air oxidation, vacuum filtration, and landfill disposal; aerobic or anaerobic digestion prior to chemical conditioning and landfill disposal; and chemical conditioning, filter press dewatering, and flash drying to produce a dry fertilizer product for sale. Estimated costs for the five options are presented for waste water treatment plants having average dry weather flows of 10, 100, and 500 mgd at estimated base capital investment costs of $5, $27, and $100 million, respectively. Additional costs for the sludge handling options, electric power consumption, and gas or oil usage/production are presented. Cost comparisons indicated that there are variable economies of scale for the different sludge handling options, with aerobic digestion at the lowest capital cost for the 10-mgd plant and the two incineration options more attractive for the larger plants. Direct operating costs are compared with respect to energy costs; costs for chemicals, supplies, and replacement parts; operating and maintenance labor costs; and costs for landfilling of the sludge or ash. The incineration options have the lowest operating costs for plants with capacities of 10-500 mgd. Sensitivities of sludge handling costs are discussed with respect to changes in chemical usage, hauling costs, and energy credits.

D087
USE OF OZONE IN THE DISINFECTION OF COLIPHAGE T-7 VIRUS,

Hacker, D. S., and Lockowitz, T.

Abbott Laboratories,
Crystal Lake, Illinois.

AIChE Symposium Series, Vol. 73, No. 166, p 242-251, 1977. 6 fig, 3 tab, 16 ref.

Results of investigations on the deactivation kinetics of E. coli bacteriophage virus with gaseous ozone in a batch, semiflow, gas-liquid reactor are presented. Virus models which have been used to explain the observed rates of virus disinfection by chemical treatment are described. Descriptions of the experimental procedures, cultures used in the study, the three-layer agar technique used for plaque assays of the bacteriophage T-7 titer, and the sterility tests on primary effluent are presented. The survival percentage of virus with time is illustrated for isothermal and constant pH systems, and compared with the pseudo-first-order decay of virus. The studies indicated that virus deactivation was governed by two general rate processes: mass transfer in the saturation of the solution by the disinfectant; and the kinetic first-order deactivation rate of the virus. The viscosity and the presence of impurities in the media did not affect the reaction rate. A mathematical model to describe the trend observed in experimental reaction data for the initial phase of deactivation and the induction period is presented.

D088

COMPOUNDS RESISTANT TO CARBON ADSORPTION IN MUNICIPAL WASTEWATER TREATMENT,

Chow, D. K., and David, M. M.

Weyerhauser Company,
Tacoma, Washington.

Journal of the American Water Works Association, Vol. 69, No. 10, p 555-561, October 1977. 5 fig, 8 tab, 64 ref.

Since waste water designated for reuse may undergo tertiary treatment consisting only of activated carbon adsorption, studies were conducted to identify compounds in municipal waste water which are resistant to carbon adsorption. Primary effluents were chemically pretreated by flocculation with FeCL or alum and the clarified liquor was passed through a sand filter and a 0.45-micron membrane filter. The chemically treated primary and biologically treated secondary effluents were passed through columns of granular activated carbon, concentrated by evaporation, filtered, and recycled through the system to simulate water reuse. Resistant compounds were analyzed with TOC content measurements, ultrafiltration for molecular size distribution, neutron-activation analysis for elemental distributions, atomic adsorption for metallic elements, UV spectroscopy for organic compounds, and thermogravimetric analysis for inorganic compounds. The elemental composition indicated that Na, N, and Cl were most resistant, followed by C, K, Fe, Ca, Zn, and Mg. Molecular size distributions indicated that molecules with relatively small sizes (less than 240 nm) accounted for 45-60% of the resistant compounds while large molecules (larger than 640 nm) accounted for only 5-18% of the total carbon content. Organic compounds identified include chlorinated hydrocarbons, aliphatic acids, aromatic amines, phenolic compounds, and calcium salts of organic acids. The major inorganic compounds which were identified included sodium and calcium salts of chlorides, nitrates, sulfates, and phosphates. Concentrations of free cyanides and metallic elements were negligible.

D089

PRETREATMENT AND CLEANING OF HYPERFILTRATION (REVERSE OSMOSIS) MEMBRANES IN MUNICIPAL WASTEWATER RENOVATION,

Belfort, G.

The Hebrew University of Jerusalem,
Israel,
School of Applied Science and Technology.

Desalination, Vol. 21, No. 3, p 285-300, September, 1977. 2 fig, 2 tab, 56 ref.

Substances contained in municipal waste water such as BOD, COD, TOC, and suspended solids can contribute to membrane fouling when using reverse osmosis or hyperfiltration as a means of treating waste water for reuse. Alternative methods for pretreatment and cleaning of membrane surfaces used in municipal waste water treatment to reduce effects associated with fouling or flux decline in reverse osmosis are reviewed. The roles that various municipal waste water constituents play in membrane fouling are described. Pretreatment methods which can be used to remove hazardous constituents from the feed to extend membrane life include pH adjustment, chemical coagulation, filtration, activated carbon adsorption, chlorination, and ultrafiltration. Geometric considerations which may affect membrane operations are discussed, including brine channel dimensions, the shear rate at the membrane-brine interface, and the ease of cleaning for the various commercially available module designs. Criteria used in the selection of membranes for hyperfiltration are described for various types of waste water. Product-flux decline of hyperfiltration membranes may be caused by membrane hydrolysis, compaction, and fouling. Physical, chemical, and other techniques for membrane cleaning are described.

D090

PHYSICOCHEMICALLY-AIDED BIOLOGICAL TREATMENT OF SEWAGE,

Jenkins, S. H., Sane, M., and Wallbank, T.

Bostock Hill and Rigby,
Birmingham, England.

Chemistry and Industry, Vol. 20, p 821-834, October, 1977. 13 fig, 9 tab, 13 ref.

A pilot plant for physicochemically-aided biological treatment at the Davyhulme Works in Manchester, England, was constructed to handle an average waste water flow of 382,000 cu m/day, of which 100,000 cu m/day is of industrial origin. Process units in the seven modes of operation tested include primary sedimentation with sludge extraction; activated sludge treatment; final clarification; flash mixing and flocculation facilities for pH control and chemical coagulation; intermediate clarification; activated carbon adsorption; automatic pH control with lime and HCl; provisions for the addition of at least three chemical coagulants at any one time; automatic sampling of raw and treated waste water throughout the plant; and primary and secondary sludge holding vessels. After a viable activated sludge process was established, studies focused on tertiary treatment of activated sludge effluent and the effects of lime and magnesium on sewage. Primary and tertiary lime sludges and return activated sludges produced during various modes of operation were measured for dry solids content, heavy metals, capillary suction time, filtration resistance, and volume. Tertiary treatment of the activated sludge effluent included sand filtration and activated carbon adsorption. Results of operation of the pilot plant from August 1975 to February 1977 are presented. Studies on lime addition indicated that addition of lime to raw sewage was more effective at reducing BOD, COD, and suspended solids in the final effluent than addition to activated sludge effluent. Removal of heavy metals, ammonia, and phosphorus were also investigated during various stages of treatment.

D091
CONTACT FILTRATION FOR PHOSPHORUS REMOVAL,

Kavanaugh, M., Eugster, J., Weber, A., and Boller, M.

Swiss Federal Institute for Water Resources and Water
Pollution Control,
Duebendorf, Switzerland.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2157-2171, October, 1977. 8 fig, 6 tab, 25 ref.

Pilot studies on the use of granular media filtration for removal of particulate phosphorus and organic carbon following mechanical-biological treatment are presented. Objectives of the studies were to examine the effects of filter media design, filtration rate, and chemical addition on the performance of granular media filters used for phosphate removal following precipitation; and to evaluate process feasibility of contact filtration for municipal waste water treatment. The study concluded that contact filtration was a viable alternative to coagulation/sedimentation or flotation, but the permissible influent filter solids concentration was dependent on the individual situation. The addition of a polyelectrolyte such as a non-ionic polymer was necessary to increase the shear resistance of flocculant solids to produce adequate solids retention. Solids removal with the three-layer and two dual-media filters was greater than 95% in runs of approximately 6 hr. Removal efficiencies were increased with an increase in the upper:lower medium depth ratio which produced a decrease in the time-averaged rate of headloss increase. Inverse relationships were observed between filtration rate/breakthrough time and the time to exhaust available head. Sand, anthracite, and pumice comprised the media used in the three-layer filter, and sand-anthracite and sand-Magnofilt were used in the dual-media filters. Of the media tested the porous granular solids, pumice and Magnofilt, exhibited lower solids capacities than anthracite at a given filtration rate and size fraction.

D092
FACTORS INFLUENCING ACTIVATED SLUDGE PROPERTIES,

Novak, J. T., Becker, H., and Zurow, A.

Missouri University,
Columbia,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 815-828, October, 1977. 17 fig, 30 ref.

In studies with sludge conditioners, cationic polymers greatly improved sludge filtration rates while anionic polymers decreased rates, indicating that activated sludge probably contained an excess of anionic polymers. An increase in filtration rate with additions of kaolinite which was more apparent with fine clay than coarse clay suggested that the anionic polymers were of large enough molecular weight for interparticle bridging. Aeration of the activated sludge initially improved filtration rate and decreased the concentration of extractable biopolymers. Studies conducted to develop a method for estimating polymer concentrations in solution on the basis of electrophoretic mobility indicated that maximum filtration rates occurred with zero colloid charge, and that the optimal polymer dose was dependent only on the supernatant liquor volume and not on the sludge solids concentration. Aeration of activated sludge in a plug flow basin was used to examine the effects of anaerobiosis on sludge characteristics. Data suggested that anaerobiosis increased polymer concentrations and decreased filtration rates. The lower optimal cationic polymer dose and filtration times observed during aeration with oxygen instead of air verified the influence of dissolved oxygen concentrations in aeration basins on the natural polymer decay rate. Experiments on sludge thickening indicated that calcium carbonate and clay were capable of drastically increasing sludge settling velocities, and that every method of sludge conditioning to improve filtration also improved sludge settling.

D093

NEW SLUDGE DIGESTORS AT MARITZBURG,

The Civil Engineer in South Africa, Vol. 19, No. 9, p 195-196, August, 1977.

International Combustion (Africa) Ltd. was contracted by the city of Pietermaritzburg in South Africa to design and construct facilities to increase the capacity of the Darvill Sewage Purification Works from a dry-weather flow of 27 million liters/day to a capacity of 54 million liters/day, with provisions for later expansion to 117 million liters/day. Since conventional sludge digestion followed by drying beds required too much land and was ineffective during periods of high rainfall in the area, high-rate digestion of sludge and treatment of settled sludge by activated sludge processes were chosen. The facility includes two 9-story high, 4500-cu m, high-rate digestors which were developed by Messrs Oswald Schultze of Germany and constructed by Bridge and Structures Ltd. The egg-shaped design of the digestors and the fact that they will be completely filled at all times should minimize scum formation. Construction of the digestors was accomplished in three stages: a lower conical section below ground, a median double-curved section, and an upper conical super structure. A six-sector shuttering system was used to pour the double-curved section. The method designed by Messrs Oswald Schultze uses an internal curved shutter, springing from a central trunnion axis with adjustable jacks to locate the inner curve of the surface. The digestors utilize a sludge retention time of 26 days, injection of influent raw sludge into the continuously circulating flow of heated sludge, and recovery of methane.

D094
PUMP APPLICATIONS IN SEWAGE SLUDGE DEWATERING PROCESSES,

Lambert, D. J.

Water and Waste Treatment, Vol. 20, No. 9, p 43-46, September, 1977. 6 fig.

A variety of treatment and disposal options are available for the estimated 1.5 million tons of sludge generated in the United Kingdom annually. Pumps can be used to transport sludges having moisture contents greater than 80%. Various sludge types, including primary, humus, seed or breeder, activated, consolidated, and digested sludges, are discussed with respect to moisture content and permissible pump speeds with helical rotor positive displacement pumps. Current commonly used dewatering processes include sludge drying beds, plate and frame filter presses, continuous or semi-continuous belt presses, roto-plug concentrators, vacuum filters, centrifuges, and incinerators. In sludge drying beds, positive displacement helical rotor/stator pumps are used where head exceeds 20 m and centrifugal pumps where head is less than 20 m. The use of helical rotor positive displacement pumps is discussed with respect to controlling the flow rate to a filter press, incinerator, vacuum filter, and centrifuge. A helical rotor pump speed selection chart is presented for selection of pump speed with respect to sludge moisture content and pump port size.

D095
AREAWIDE WASTEWATER MANAGEMENT FOR METROPOLITAN DES MOINES,

Weber, C. L.

Kirkham, Michael and Associates,
Omaha, Nebraska.

Public Works, Vol. 108, No. 10, p 72-74, October, 1977. 1 fig, 1 tab.

The Des Moines Areawide Waste Treatment Management Planning Program was created in response to water quality standards imposed by Public Law 92-500 and by the Iowa Water Quality Commission. An embargo placed on all new sanitary connections within the Des Moines area was later suspended for 90 days, to allow the 23 local governments to develop a framework in which to meet sewer planning agreements. The Central Iowa Regional Association of Local Governments (CIRAIG) in conjunction with state, local, and federal agencies set goals for the program: to protect surface and groundwater quality; to implement and carry out an areawide waste treatment planning program; to examine current population trends in the area; to construct new and rehabilitate existing waste water and drainage facilities; and to examine costs and land use requirements. Specific problems addressed by the planning program were the alleviation of combined sewer overflows and basement backups during wet weather, and the resolution of problems associated with assessment of sewage treatment charges to participating municipalities. The technical plant recommended for a population of 400,000 included individual waste water collection systems for 13 communities in the planning and the construction of a regional treatment facility adjacent to the existing Des Moines main treatment plant. The regional treatment plant has a design capacity of 50 mgd and includes several large equalization basins to store sanitary flows during periods of heavy rainfall.

D096

LIQUID WASTE EFFLUENT INSTALLATION UNVEILED IN FLA.,

Water and Wastes Engineering, Vol. 14, No. 9, p 133, September, 1977.

A center pivot irrigation system manufactured by Valmont Industries, Inc., is being used at waste water treatment facilities in Winter Haven, Florida, for spray irrigation of approximately 1500 acres of forage crops with municipal effluents. During treatment of the 5-mgd activated sludge plant, raw waste first passes through an aerated grit chamber for grit removal and odor control. It is then mixed with return activated sludge from the clarifiers and aerated. After aeration and clarification, the sludge is siphoned off the clarifier bottom for mixing with incoming raw waste water. The clarified effluent is chlorinated and pumped to a holding pond. Two aerobic digesters handle the excess sludge, which is then sent to a gravity thickener and centrifuge before disposal to farmland. The treatment process removes 95% of BOD and suspended solids in the raw waste water; remaining organics and nutrients are removed by spray irrigation. The 9 center pivots used to distribute the treated effluent are equipped with 7 drive units per system. The systems which are electrically propelled provide coverage for 70 acres each and are capable of distributing 450 gpm. The forage crops which are expected to remove approximately 550 lbs N/acre/yr will receive approximately 475-500 lbs N/acre/yr from irrigation with waste water effluents. The effects of effluent application are monitored with 36 wells 10-30 ft deep located throughout the irrigation site.

D097

EFFECTS OF ANAEROBICALLY DIGESTED MUNICIPAL SEWAGE SLUDGE APPLICATION ON CHEMICAL PROPERTIES OF SELECTED SOILS WITH EMPHASIS ON DISTRIBUTION OF ZINC AND CADMIUM FORMS,

Koenig, A.

Dissertation Abstracts International B, Vol. 38, No. 3, p 1369-1370, 1977.

Sixteen parallel experiments with a series of 10 batch reactors containing a mixture of dried anaerobically digested municipal sewage sludge and soil in specific proportions were used to investigate the effects of sewage sludge application on chemical properties of soils. The study evaluated the rate and extent of changes and degradation of sewage sludge; various zinc and cadmium forms in soil-sludge mixtures; nitrogen in soils; and zinc and cadmium in leachate with respect to temperature, water regime of soil-sludge mixtures, soil type, and sludge application rate. Zinc and cadmium in soluble, exchangeable, complexed, organic, and available forms were determined with an operational extraction scheme and sequential destructive analyses. The studies indicated that the transformation of metals in sludge-amended soils was most affected by organic matter degradation and nitrification which were, in turn, influenced by temperature, pH, moisture content, and organic matter content. Zinc and cadmium were not present in leachates, although nitrates and salts were apparent.

D098
IMPROVING SLUDGE FILTER PERFORMANCE,

Water and Waste Treatment, Vol. 20, No. 9, p 36, September, 1977. 1 fig.

Chemical conditioning has been used to reduce sludge volume so that sludge dewatering equipment can be used to its full potential. Laporte Industries Ltd. in Widnes, England, provides two flocculants, aluminum chlorohydrate and Lapofloc P.A.C., for use in the water and waste water treatment industries at 15% (w/w) and 10% (w/w) Al203, respectively. Lapofloc, a polyelectrolyte, is suggested for use with secondary sludges. Conditioning of sludge on a rotary vacuum filter designed to use aluminum chlorohydrate with 2.6% Al203 and 10% lime provided a yield of 1.8 lb/sq ft/hr, while conditioning with Lapofloc at a dose level of 1.5% Al203 produced a cake discharge of 2.5 lb/sq ft/hr. The addition of hydrogen peroxide, available from Interox Chemicals Ltd., a joint Laporte-Solvay company, is suggested for alleviation of problems associated with the production of hydrogen sulfide during sludge handling.

D099
HOSPITAL'S WASTE,

Water and Waste Treatment, Vol. 20, No. 9, p 54, 56, September, 1977.

The Tuke and Bell gravity-filled ejector system, the Electromatic Sewage Ejector, has replaced centrifugal pumps previously used for sewage transport at a hospital under the jurisdiction of the East Anglian Water Authority in England. The problematic hospital sewage, which frequently clogged suction pipework, pump casings, and delivery valve systems, had created problems with operation and maintenance of the centrifugal pump system. To accommodate the required design capacity of 150 gpm, special ejector bodies were designed and 22 KW compressors were used to provide the necessary flow rate. Since unscreened refuse could not be discharged directly to the main sewer, the inlet chamber was equipped with a roller screen on skids operated by an electric motor. Rotary valve or electrode control units were not required with the Electromatic ejector. Operations were controlled by the displacement of a small amount of air through nylon transfer tubes by influent to control opening and closing of the solenoid.

D100
MAINE'S PERSPECTIVE ON COMPOSTING TOILETS AND ALTERNATE GREYWATER SYSTEMS,

Moreau, E.

Waste Water and Plumbing Control,
Department of Human Services,
Division of Health Engineering,
Augusta, Maine.

Compost Science, Vol. 18, No. 4, p 18-19, July-August, 1977.

After review of extensive studies in Sweden and other countries, the state of Maine in 1974 became the first in the United States to authorize the installation of compost toilets. Although current technology does not favor the replacement of existing household toilet facilities with compost systems, experiences with more than 200 compost toilets installed in Maine have been favorable. An exhibition was held in Augusta, Maine, in 1975 for the introduction of various alternatives to conventional toilet systems. A greywater treatment system is required by the Maine State Plumbing Code when composting or waterless toilets are used in residences with running water under pressure. The system normally includes a septic tank and a soil disposal field, for treatment of greywater which can include grease, fats, food solids, and bacteria in a relatively undiluted form. The drainage field for a separated system is usually 200-1000 sq ft as compared to 300-1400 sq ft with a combined system. Changes in Maine's exterior plumbing code to further encourage water conservation are expected.

D101
FACTORY-BUILT PLANTS AID EXPANSION PLANS,

Schnulle, G.

Reclamation Center,
Carol Stream, Illinois.

Public Works, Vol. 108, No. 11, p 73-74, November, 1977. 1 fig.

Three steel factory-built units manufactured by Smith and Loveless Division of Ecodyne Corporation were used in the construction of waste water treatment facilities which included secondary treatment followed by tertiary treatment with filtration. Each unit includes an activated sludge contact-stabilization chamber and integral arrangements for sludge reaeration, settling, and aerobic digestion. The units, which have capacities of 1.0, 1.0, and 0.5 mgd, were designed with concentric circular shells. After aeration and retention for 4-5 hrs, waste water flows by gravity to a clarifier in the center of each unit where it is retained for 4-5 hrs. The settled sludge is then pumped to either the aerobic digester or reaeration section. Clarifier overflow passes to one of three concrete settling tanks and then to one of six dual-media filters which contain anthracite and sand. Filter backwash is recycled through the plant and the effluent is disinfected with chlorination before discharge to Klein Creek. A belt filter press with an integral chemical conditioning unit is used to dewater the sludge to a solids concentration of 10-12%. The sludge cake is disposed by landtilling. While the domestic wastewater has an average BOD of 250 mg/liter and suspended soilds of 200 mg/liter, the plant also receives 0.7 mgd of waste water at a BOD of 350 mg/liter from a nearby industrial park which includes a jam and jelly manufacturer. BOD and suspended solids in the final effluent average 1-2 mg/liter, and ammonia about 0.4 mg/liter.

D102

KEEP YOUR DIGESTER IN GOOD SHAPE,

Barber, N. R.

Church and Dwight Company, Incorporated,
Piscataway, New Jersey.

Water and Wastes Engineering, Vol. 14, No. 9, p 55, 59, September, 1977. 1 fig.

Sodium bicarbonate has been used to safeguard against chemical malfunction of anaerobic digestion caused by the accumulation of volatile acids and carbon dioxide. Since $NaHCO3$ can directly shift the equilibrium to any desired value without first reacting with soluble $CO2$, it has been used as an alternative to lime, which can produce undesirable side effects such as vacuum and/or precipitation. With lime addition, the removal of $CO2$ from the digester head room to replenish the $CO2$ taken out of the solution can create an instantaneous vacuum which places stresses on tank structures. This may, in turn, allow oxygen to enter the system with resulting toxicity to the anaerobic organisms in the digester. Scale formation due to the precipitation of $CaCO3$ after it reaches its solubility limit can also present problems. An equation representing the increase in bicarbonate alkalinity caused by the reaction of lime with soluble $CO2$ is presented. Calculations indicated that scale formation is likely at $CaCO3$ concentrations greater than 500 mg/liter or at lime concentrations greater than 370 mg/liter. An equation to estimate the required alkalinity for buffering the pH at different levels of $CO2$ partial pressure is presented. $NaHCO3$, a natural pH control buffer in all aqueous systems, has a toxicity level in anaerobic digestion systems of 0.2 moles Na/liter for slug wastes when other ions are at concentrations below 10 mg/liter. The presence of antagonistic ions such as K and Ca may increase the tolerable level of Na to digester organisms.

D103

BIG SQUEEZE FOR SLUDGE KEEPS CAKE ON THE GO,

New Scientist, Vol. 76, No. 1077, p 349, November, 1977.

Edward and Jones of Stoke-on-Trent in England have developed a continuous filter press for large-scale dewatering of slurries encountered in the sewage treatment industry. A flocculating agent is first used to create small solid particle aggregates in the sludge to facilitate dewatering. The slurry is then screened with a rotating drum equipped with fine mesh steel walls to produce a slurry solid enough for handling on a moving belt. The second stage of dewatering is accomplished by sludge compression between two belts and two sets of rollers. During the third and final stage of dewatering, the sludge passes between two caterpillar tracks made of PVC slats. High-pressure hydraulic jacks compress the upper track, which runs on rollers attached to a moveable frame, against the lower track which is mounted on rollers attached to a rigid frame. The hydraulic sludge press is reported to produce a sludge cake of comparable consistency to that produced by a conventional filter press.

D104

ANTIGONISH CHOOSES AERATED LAGOONS FOR WASTEWATER TREATMENT SYSTEM,

Chisholm, C. H.

Office of the Mayor,
Antigonish, Nova Scotia, Canada.

Water and Pollution Control, Vol. 115, No. 9, p 25-26, September, 1977.

A. H. Roy and Associates Ltd. have designed a 1-mgd waste water treatment facility for the town of Antigonish in Nova Scotia, Canada. A system of three aerated lagoons was chosen for the 18-acre available site which would provide sewage treatment for the town's 6,000 residents, for the 4,000 residents of St. Francis Xavier University, and for other nearby towns. Designed for a BOD loading of 1700 lb/day, the combined capacity of the three lagoons is 29.6 million gal with an average retention time of 29.6 days to allow for shock conditions created by storm water flows. The 10-ft deep lagoons provide a total surface of 9.8 acres, the first lagoon being the largest at 3.5 acres with bottom dimensions of 250 x 508 ft. Aeration of the system is accomplished by three 25-hp blowers with one of the units serving as a standby. The town managed the $518,000 project, saving well over $100,000 in construction costs by hiring nine specialized contractors for individual phases of the project. Problems with odor after start-up were alleviated by removal of grease which had accumulated on the surface of the first lagoon. Blower noise was muffled by the installation of a sound plenum in the air intake. Operation of the aerated lagoon system has improved the water quality of the West River and Antigonish Harbor.

D105

REACTOR CLARIFIERS,

Effluent and Water Treatment Journal, Vol. 17, No. 8, p 427, August, 1977.

Flocculation and clarification have been widely used in the water and waste water treatment industries for removal of suspended solids, algae, and color. High rate solids-contact reactor clarifiers have been developed by Emico. The top diameter of a bell-shaped reactor for a 200-ft diam clarifier would be approximately 50 ft with a turbine diameter of 28 ft. Influent is fed horizontally through the tank side wall and reactor well wall into the recirculation cylinder. The unit combines flocculation, coagulation, clarification, and positive sludge removing capability in a single tank. The unit's other functions include removal of silica, suspended solids, BOD, and COD; precipitation; and lime-soda or brine softening. In handling raw water from rivers and wells, the high rate solids contacting unit is capable of reducing turbidity from 20 ppm to 1 ppm. Additional applications of the Emico units are described.

D106

EFFECTS OF SODIUM BENTONITE AND FERRIC CHLORIDE ON ACTIVATED SLUDGE TREATMENT OF WASTEWATER,

Mirzadeh, A., Maeda, Y., and Fazeli, A.

Arya-Mehr University of Technology,
Tehran, Iran,
Biochemical and Bioenvironmental Research Center.

Journal of Fermentation Technology, Vol. 55, No. 3, p 258-264, 1977. 4 fig, 4 tab, 17 ref.

The enhancement of microbial flocculation in the activated sludge system by the addition of sodium bentonite and ferric chloride was investigated in batch and continuous tests with activated sludge and artificial sewage. Sodium bentonite and ferric chloride were added to mixed liquor in an aeration tank and the oxygen uptake rate of the activated sludge was monitored. Other parameters examined included specific filtration resistance, sludge volume index, settling rate, and the specific substrate (COD) utilization rate. The addition of sodium bentonite did not significantly affect the sludge respiration activity. The loss of sodium bentonite was reduced by the addition of ferric chloride, enhancing the settling rate, filtration resistance, and sludge volume index. Reductions in substrate utilization rates and activated sludge respiration with the addition of ferric chloride were attributed to physiological effects on sludge bacteria and protozoa. Although the use of bentonite and ferric chloride did not significantly enhance microbial flocculation, the data obtained in this study may be useful in the treatment of wastes which contain these chemicals.

D107

CATALYTIC OZONATION IN AQUEOUS SYSTEMS,

Chen, J. H., Hui, C., Keller, T., and Smith, G.

AIChE Symposium Series, Vol. 73, No. 167, p 206-212, 1977. 14 fig, 1 tab, 9 ref.

A steady-state packed bed reactor was used in the investigation of catalytic ozonation with Fe203 as a catalyst for municipal and industrial waste waters. Dilute solutions of phenol and ethyl acetoacetate were used to simulate wastes, and TOC and COD were continuously monitored in the liquid effluent. The system was run at various gas flow rates, ozone concentrations, liquid retention times, and feed concentrations. Studies with aqueous phenol solutions indicated that removal efficiency increased with retention time and decreased with influent COD concentrations. Operating conditions for a percentage of COD removal equal to the percentage of ozone consumed were an ozone concentration of 16 mg/liter and a liquid retention time of 33 min, or at 30 mg/liter and 20 min. The stoichiometric relationship for ozonation of aqueous phenols is presented as 1 mole of C6H50H and 14 moles of 03 yielding 6 moles of CO2, 3 moles of H20, and 14 moles of 02. Experiments on catalytic ozonation of industrial wastes supplied by Nalco Chemical Company were conducted with wastes which had a TOC of 459 mg/liter and a pH of 6.8. Analyses of TOC in the ozonated effluent indicated that the presence of a catalyst during exposure to ozone significantly enhanced TOC removal.

D108

CITY REAPS INCOME FROM SLUDGE PROCESSING SYSTEM,

Knapp, I. M.

Public Works, Vol. 108, No. 10, p 103-105, 118, October, 1977.

A sludge processing system which would produce a product that could be sold as a soil conditioner/fertilizer has been chosen by the city of Largo, Florida as a means of waste disposal. Additional cost estimates indicate that the $800,500 facility could produce a marketable soil conditioner at a cost of $45-60/ton which could be sold at $160-250/ton. The facility is designed to dry and package sludge resulting from the treatment of 9 mgd of municipal wastes. Industrial wastes are excluded from the sludge, eliminating any deleterious effects produced by heavy metals. Nutrients can be added automatically to meet requirements for different soil conditions. The plant is entirely automated and only requires one operator for startup. A digester/clarifier increases the influent sludge solids content from 1% to 3%. The sludge is then pumped to a blender for flocculation with a polymer and combined with a portion of previously dried sludge. Filter belt presses further dewater the sludge to a cake form. The remaining water is evaporated in a rotary, three-pass drum dryer through which an air stream at 800-900 F passes. The dried sludge is then packaged in three-ply, plastic-lined bags. Actual total operating costs for a 6-month test period were $140/ton and packaged fertilizer was sold at $100-160/ton, depending on the quantity of sludge purchased. The addition of a prethickener/conditioner step to the process is expected to further reduce production costs.

D109
CHIPPING NORTON STW--INAUGURATION OF CONTRACT,

Water Services, Vol. 81, No. 978, p 454, August, 1977.

The Chipping Norton sewage treatment works are being constructed for the Thames Water Authority at a cost of more than 500,000 pounds. Principal contractor for the facility which will provide sewage treatment for a population of 13,000 is Kimbell Construction Ltd. of South Northampton, England. The facility should produce effluent with a BOD of 15 mg/liter and suspended solids of 12 mg/liter. The plant will incorporate new sludge pressing facilities completed earlier in 1977. The proposed Chipping Norton plant includes preliminary treatment, an aeration ditch, circular storm and settling tanks, a storm irrigation area, and various pumping stations. Whitehead and Poole Ltd. is the principal mechanical contractor for the project. Screw pumps and tank scrapers will be provided by New Haden Pumps. The pista grit trap and clarifier are produced by Jones and Attwood Ltd. and the sludge pump by Pegson Ltd. The booster set to be used at the plant is manufactured by Megator Pumps and Compressors Ltd. Scheduled for completion in the latter part of 1978, the new facility will completely replace the existing works.

D110
POLIO-VIRUS ADSORPTION FROM WATER ONTO SILICATE MINERALS,

Lo, S. H., and Sproul, O. J.

Maine University,
Orono,
Department of Civil Engineering.

Water Research, Vol. 11, No. 8, p 653-658, 1977. 6 tab, 19 ref.

Batch studies and column experiments were used to investigate virus adsorption on silicate minerals in natural water and treated domestic waste water under controlled conditions. In the first phase of the experiments, the degree of adsorption of poliovirus type I was examined with secondary effluent from the University Park Sewage Plant in Orono, Maine, and six silicate minerals: actinolite, enstatite, kyanite, microcline, olivine, and sillimanite. In batch experiments, virus removal ranged from 51% to 78% for the different silicate species, and only a minor part of the surface area of the granular particles was occupied by viruses. Actual adsorption capacities ranged from 642,000 to 895,000 PFU per mg of silicate mineral. When organic material was added to the system, virus adsorption decreased to about 15-20% as a result of competitive adsorption. In the second series of experiments, poliovirus movement through a microcline-filled column was investigated with biologically treated domestic waste water effluent applied at a rate of 0.61 cu m/day-sq m. With a natural water system, virus started to appear in the column effluent after 6 days and 99% removal was still being achieved after 13 days. With waste water, virus appeared in the column effluent after 1.33 days. The lower removal efficiency with waste water was attributed to competitive adsorption in the presence of organic materials. Comparisons of the adsorptive capacities of the individual silicate minerals revealed that olivine adsorbed more viruses per unit weight than the other mineral species. It was suggested that the degree of adsorption was greater for minerals with higher acidity.

D111

INFLUENCE OF TEMPERATURE AND U.V. LIGHT ON DISINFECTION WITH OZONE,

Farooq, S., Engelbrecht, R. S., and Chian, E. S. K.

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Urbana,
Department of Civil Engineering.

Water Research, Vol. 11, No. 8, p 737-741, 1977. 6 fig, 11 ref.

Laboratory studies with the acid-fast bacteria, Mycobacterium fortuitum, were used to examine the effects of temperature and ultraviolet light on the degree of inactivation of microorganisms by ozone. Deionized buffered water innoculated with test organisms was fed to a continuous flow-type reactor. The partial pressure of gaseous ozone was kept at 16.8 mg/liter with an ozone-air gas flow rate of 0.5l/min. The effect of temperature on the survival of M. fortuitum was examined at a constant rate of applied ozone and at varying ozone residuals at 9, 20, 30, and 40 C. Studies indicated that the degree of inactivation increased with the ozone residual and with temperature. The second series of experiments on the effect of temperature was conducted at constant ozone residuals maintained by varying the partial pressure of applied ozone. Results indicated that the disinfection efficiency increased significantly with temperature. A value of 18.3 Kcal was calculated from temperature data for the activation energy for ozone disinfection. The chemical reaction rate between ozone and bacterial cells was suggested as the rate-limiting step in ozone disinfection at pH 7.0. The effect of ultraviolet light on ozone disinfection was investigated with activated sludge effluent equilibrated with M. fortuitum. Studies indicated that although ultraviolet light did not enhance ozone efficiency, ultraviolet light alone did have significant disinfecting abilities.

D112

VARIABLE SPEED PUMPING FOR PROCESS AND MAINS WATER BOOSTING WITH ACCURATE CONTROL,

Water Services, Vol. 81, No. 978, p 488, 493, August, 1977.

Fluctuations in fluid pressure in a water or waste water system can be accommodated with variable-speed pumping accomplished with variable-speed motors or multipump additive systems. Applications of variable-speed pumping in England are described. The Peerless Hydroconstant System is used by the brewing industry to compensate for pressure loss as filters clog. The system is also used in water heating systems to compensate for vapor pressure when the water is above the boiling point. Surges in flow which may upset biological treatment processes in a sewage treatment plant can be controlled with the Peerless system. Variable-speed pumping is also used to meet varying demands on water supplies in primary pumping from reservoirs and to augment existing pressure. Power savings resulting from the use of variable-speed pumping are proportional to the amount of time the pump is running at low speeds.

D113

STUDIES ON SEPARATION OF ALGAE FROM STABILIZATION POND EFFLUENTS BY COAGULATION,

Sastry, C. A., Rao, M. N., and Rao, A. V.

National Environmental Engineering Research Institute,
Zonal Laboratory,
Madras, India.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 91-94, June, 1977. 8 tab, 6 ref.

India's sunny climate and the economy of the process have led to the widespread use of waste stabilization ponds as a means of waste water treatment in India. Algal cell material produced in the ponds is suggested as a source of protein for animal feed supplements. Coagulation of algae in stabilization pond effluents with nirmali (Strychnos potatorum) seed extracts and alum was investigated with effluents obtained from the Shahpura Oxidation Ponds in Bhopal, India. The four 201 x 50 x 1-m ponds are each divided into two equal primary and secondary units and are designed to treat a total of 3 mgd of municipal wastes from Bhopal. Algal species observed in the test effluents are listed. In studies with alum doses of 120-240 mg/liter and effluents containing 250,000-267,000 algae per ml, 95-97% of the algae was coagulated with an alum dose of 240 mg/liter. In studies with flocculation times of 5-30 min, optimum algae removal was obtained with a flocculation time of 20-25 min and a settling time of 30 min. Algae removal was also investigated with polyelectrolytes at doses of 0-10 mg/liter using Magnifloc 990, Separan NP 10, Wisprofloc, and nirmali seed extract. While nirmali seed was more effective than the other agents, polyelectrolytes used alone were not as effective in coagulating algae as the alum. Studies on the use of nirmali seed extract in conjunction with alum indicated that 98-99% removal of algae could be obtained with an alum dose of 180 mg/liter and a nirmali seed extract dose of 8 mg/liter.

D114
TREATMENT FACILITIES EXPANDED AT DENVER SEWAGE DISTRICT,

Water and Wastes Engineering, Vol. 14, No. 9, p 94, September, 1977.

A $37-million expansion project for the Central Waste Water Treatment Plant was designed by CH2M Hill and Culp Wesner Culp for the Metropolitan Denver Sewage Disposal District No. 1. The project increased the total treatment capacity from 98 mgd to 170 mgd, and increased the primary capacity by 150% and the secondary capacity by 75%. Additions to the primary treatment facility included three continuous rake bar screens and conveyor belt; two grit washers and clarification units; two hoppers for temporary holding of screenings and grit; two gravity grit basins; four center-feed clarifiers with grease removal; and six piston sludge pumps. Secondary treatment is provided by six vertical propeller low lift pumps, eight three-chambered aeration basins, rim collection clarifiers with grease removal, six pumps for return activated sludge, two pumps for waste activated sludge, and eight aerobic digesters. The aerobic digesters were added to reduce the volume of sludge handled and to stabilize the product for agricultural use. The digesters include a gas mixing system and a heat exchange system, so that methane produced during digestion can be used to maintain a sludge temperature of 95 F. The digested/stabilized sludge product from the sludge drying and distribution system will be used as a soil conditioner and fertilizer.

D115
DEVELOPMENTS IN THE TREATMENT OF EFFLUENT,

Waud, A.

Robert Hudson (Raletrux) Limited,
Leeds, Yorkshire, England.

Water Services, Vol. 81, No. 978, p 510, August, 1977.

A series of tank scrapers and screens has been manufactured by the Effluent Division of Robert Hudson (Raletrux) Ltd. of Leeds, Yorkshire, England. The Auto-Sludge rectangular scraper was developed for use in storm water tanks, sludge holding tanks, primary and secondary settling tanks, and rectangular clarifiers. The scrapers are equipped with a self-contained drive unit, can be totally submerged during operation, and do not require routine maintenance. The Bio-Screen range of solids removal screens and the Roto-Sludge range of rotating half-bridge scrapers for circular tanks are also produced by Hudson. The Bio-Screen can be used in most shallow channels which are rectangular in cross-section, with either a bar screening surface and rake mechanism or a perforated plate screen surface and brush mechanism. Special features of the Bio-Screen include the adjustable angle of the screen surface and the specially-designed closed circuit winch for removing and elevating screenings. The Roto-Sludge includes a special scum removal device, a tripod central support with a universal bearing arrangement, and a box girder design for the rotating bridge.

D116

EQUILIBRIUM OPERATION OF SUBSURFACE ABSORPTION SYSTEMS,

Kropf, F. W., Laak, R., and Healey, A. K.

Connecticut University,
Storrs,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 9, p 2007-2016, September, 1977. 6 fig, 3 tab, 27 ref.

Land application of waste water as a means of tertiary treatment and disposal may be hindered by reductions in waste water absorption by soils due to clogging of the soil interstices and the production of a biological mat. The objectives of this study were to examine the infiltration rate through the clogging mat and to develop design and operational criteria for subsurface absorption systems which could operate at equilibrium on a long-term basis. Experimental aspects of the laboratory-scale studies are discussed, including: test samples, selection of soils, preparation and packing of soil columns, flooding schedules, improved (tall) soil columns, sidewall infiltration, and operation of the model. The studies evaluated continuous vs. intermittent flooding, characteristics and breakthrough of the slime layer, changes in hydraulic gradient, the influence of soil characteristics, sidewall vs. bottom infiltration, extended continuous inundation, and long-term acceptance rate. Results indicated that continuous inundation did not produce a higher infiltration rate than intermittent dosing and that the infiltration rate was related to the hydraulic gradient. Studies also indicated that infiltration surfaces were not permanently clogged. Reductions in infiltration by the presence of a slime layer were independent of the soil porosity. Infiltration rates of 10-20 mm/day (0.2-0.5 gpd/sq ft) are predicted for all wetted surfaces.

D117

FERRIC CHLORIDE TREATMENT REDUCES RIVER'S PHOSPHOROUS DISCHARGE,

Garber, L. L.

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Department of Chemistry.

Water and Sewage Works, Vol. 124, No. 10, p 54-57, October, 1977. 2 fig, 5 tab, 16 ref.

The effects of the addition of a tertiary system for phosphorus removal to the South Bend waste water treatment plant on the water quality of the St. Joseph River in Indiana were investigated. Concentrations of ortho-phosphate P, polyphosphate P, and organic P were measured in grab and composite samples collected at six sites along the St. Joseph River from September 1974 to August 1975. Phosphorus removal at the South Bend plant was accomplished by precipitation with ferric chloride and flocculation of the produced solids with an anionic polyelectrolyte. The 48-mgd system included two 200-ft dia upflow clarifiers. A typical ferric chloride dosage of 5.8 mg/liter was added to effluent from the secondary clarifiers. The anionic polyelectrolyte was then added to the waste water as it flowed into the base of the upflow clarifiers. The low variation in phosphorus levels for samples obtained at various sites throughout the city indicated that municipal wastes did not present a significant contribution to the phosphorus levels in the river during dry weather flow. Before the addition of phosphorus removal at the South Bend plant, the treatment plant effluent was reported as increasing the orthophosphate levels in the river by 88%. After the addition of tertiary treatment, plant effluent caused only nominal increases in orthophosphate and organic phosphate levels and a slight decrease in polyphosphate levels.

D118

STUDY DISCLAIMS CONTACT STABILIZATION SUPERIORITY OVER SINGLE TANK AERATION,

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Department of Civil Engineering.

Water and Sewage Works, Vol. 124, No. 10, p 86-93, October, 1977. 4 fig, 12 tab, 16 ref.

Laboratory-scale studies compared the two-tank aeration activated sludge process (contact stabilization) with the single-tank systems (high rate, conventional, and completely mixed processes). Five tests were performed with synthetic waste water and treatment plant influent under batch and continuous conditions. In the first test, contact stabilization was compared with the conventional process. The second and third tests compared the biosorption process with high rate or modified activated sludge process under short-term aeration. The fourth and fifth tests evaluated single-tank and two-tank activated sludge processes under constant and variable hydraulic loads, respectively. Results of the various tests conducted in this study and of previous laboratory and pilot plant investigations are presented. The study concluded that reaeration of the return sludge in a two-tank aeration activated sludge system did not always significantly enhance the BOD or COD removal rates. The single-tank aeration process was better at absorbing mild shocks induced by fluctuating hydraulic and organic loads. The positioning of aeration tanks before and after secondary settling basins offers process flexibility with the use of the reaeration tank as a temporary storage facility. A contact stabilization unit is suggested as resulting in a higher organic load removal per unit volume of aeration tank than a conventional activated sludge process.

D119

SLUDGE DEWATERING--A TASK THE RIGHT EQUIPMENT MAKES EASIER,

The American City and County, Vol. 92, No. 10, p 49-52, October, 1977. 1 fig, 1 tab.

Various methods are available for dewatering sludge produced during waste water treatment, including rotary vacuum filters, centrifuges, drying beds, lagoons, filter presses, and horizontal belt filters. Vacuum filter performance is related to the type of covering used, the size distribution of solid particles in the sludge, and the cake discharge mechanism employed. Operation of the coil vacuum filter is described. The main variables which affect sludge dewatering by centrifugation include: bowl design, length:diameter ratio, bowl angle, flow pattern, bowl speed, pool volume, conveyor design, relative conveyor speed, and sludge feed rate. Various types of centrifuges are discussed, including the solid bowl countercurrent centrifuge, continuous concurrent flow solid bowl conveyor centrifuge, basket centrifuges, and disc centrifuges. Design and operating criteria related to drying beds are discussed. Lagoon drying, commonly used in areas where large areas of land are available, is discussed. The filter press, in which sludge is dewatered by compression between vertical plates faced with filter cloth, is discussed. Additional types of dewatering devices which are described include moving screen concentrators, belt pressure filters, capillary dewatering systems, and rotating gravity concentrators.

D120

SEWAGE SLUDGE AND HOW TO SELL IT,

Knapp, I. M.

The American City and County, Vol. 92, No. 10, p 63-65, October, 1977. 1 fig, 1 tab.

An $800,500 sludge processing plant capable of producing a dry pelletized soil conditioner from municipal sludge is being used by the city of Largo in

Pinellas County, Florida. The sludge treatment/disposal system was designed as part of a 3.0-mgd expansion project for the existing sewage treatment plant. Experiences in the marketing and promotion of Largo's dried pelletized sludge, sold as "LarGrow", are described. Initial production costs were $140/ton while the expected revenues from the sale of the soil conditioner were $80-100/ton. The addition of a sludge prethickener/conditioner process is expected to reduce the operating costs to the $50-80/ton range. An additional advantage presented by the disposal system is that the sale of "LarGrow" to residents of the surrounding area eliminates transportation and application costs for the treatment plant. After thickening in three in-ground conical tanks, the wet sludge cake is combined with previously dried sludge to reduce the moisture content. A drum dryer is used to remove the remaining moisture. Some of the dried sludge is retained for mixing with incoming thickened sludge, and the remainder is conveyed to a dry product storage bin. The uniformly-sized pelletized product is packed in self-sealing, three-ply, poly-lined bags.

D121

CO-DISPOSAL OF SEWAGE SLUDGE AND SOLID WASTES--IT WORKS,

Sussman, D. B.

Resource Recovery Division,
United States Environmental Protection Agency,
Washington, District of Columbia.

The American City and County, Vol. 92, No. 10, p 55-58, October, 1977. 1 fig.

Since municipal sludge has a heat value of 10,000 BTU per lb of dry solids and is autogenous at a moisture:solids ratio of 70:30, co-disposal of solid waste and municipal sludge is suggested so that the energy produced by the combustion of solid waste can be used to dewater sludge to its autogenous point. Basic approaches to co-disposal include the use of sludge incinerators with the organic portion of solid waste as a fuel to dry, burn, and reduce the volume of sludge; and the use of a solid waste incinerator, solid waste-fired steam generator, or waterwall combustion unit to burn dewatered sludge. The use of a fluidized bed furnace for co-disposal in an EPA-supported demonstration at Franklin, Ohio, is described. The facility at Franklin was also designed to recover a low grade paper fiber, ferrous and nonferrous metals, and glass from the solid waste stream and to use fuel derived from the nonrecoverable organic portions of the waste to operate the sludge incinerator. The modification of an existing multiple hearth sludge incinerator to accept refuse-derived fuel and operate in either an incineration or pyrolysis mode at a facility in Concord, California, is described. Experiences with the use of a solid waste incinerator as a sludge volume reduction unit are described for Ansonia, Connecticut; Norwalk, Connecticut; Holyoke, Massachusetts; and other municipalities. The direct use of heat from burning solid waste to dewater and burn sludge was demonstrated in Glen Cove, New York.

D122

KINETICS OF CELL GROWTH AND BACTERIA PROLIFERATION IN ACTIVATED SLUDGE TREATMENT (A sejtanyag, illetve bakterium- szaporulat kinetikaja az eleveniszapos eljarasban),

Ghobrial, F. H.

Hidrologiai Kozlony, Vol. 57, No. 5, p 193-198, May, 1977. 4 fig, 3 tab, 10 ref.

Cell growth and bacterial proliferation in completely-mixed activated sludge systems with batch and continuous operation were examined using activated sludge samples from the South Pest treatment plant in Hungary. A new theoretical approach assumes that bacteria use the energy of substrate oxidation for microbial synthesis with only limited efficiency, and that part of this energy leaves the system in the form of heat. The studies concluded that bacterial growth, the biological use efficiency of the energy produced, and the endogenous decay factor were constant under the same physical and chemical conditions. Measurements of mixed liquor suspended solids were considered to be more practical and more easily obtained than measurements of live bacterial mass.

D123

HIGHLY ADVANCED SEWAGE TREATMENT (Hochentwickelte Abwasserreinigung),

Wasser, Luft, und Betrieb, Vol. 21, No. 7, p 405-406, 1977. 3 fig.

Percolation bodies made of PLASdek blocks and their uses in municipal waste water treatment are described. The percolation bodies consist of blocks measuring 1,200 mm x 600 mm x 500 mm. They can be used for high-efficiency purification of municipal waste water, especially where chemical precipitation is required. The bacterial flora is rapidly regenerated after chemical attack. Two-stage percolation bodies with fixed nozzle or rotary disk water distribution systems have an efficiency of 90% and over in terms of the reduction of BOD and phosphorus contents.

D124

CENTRIFUGAL DEWATERING OF MUNICIPAL AND INDUSTRIAL SLUDGE,

Asano, T., Suzuki, T., and Hayakawa, N.

Water and Sewage Works, Vol. 124, No. 9, p 130-135, September, 1977. 9 fig, 3 tab.

Sludge dewaterability was investigated with a horizontal continuous cylindrical-conical centrifuge which was manufactured by Nishihara Environmental Sanitation Research Corporation Limited in Tokyo, Japan. The Model SD-700P centrifuge includes a sludge feed pump, chemical feed pump, chemical mixing tank, flow meters, atmospheric moisture control unit, effluent inspection window, and an operation control panel. Results of the use of the centrifuge with various types of municipal, industrial, and water treatment sludges are presented. Flonac, a cationic organic polymer, was evaluated with regard to improving suspended solids recovery. With digested mixed, primary and activated sludges, solids recovery was 48-80% without polymer addition and over 99% with the addition of Flonac. Suspended solid capture for raw primary sludge was 73-96% without Flonac and over 98% with polymer addition. Polymer addition to mixed raw primary and activated sludges increased solids recovery from 61% to approximately 98%. Suspended solids capture with activated sludge was 40-97% without polymer addition and more than 98% recovery with the polymer. Suspended solids capture with aerobic digested sludge was increased from 55% to 98% with the addition of a polymer. A nonionic organic polymer (Aquafloc 30) and an anionic polymer (Aquafloc 305) significantly improved the dewaterability of water filtration plant sludge. Process and operational variables which may affect sludge dewaterability, such as sludge feed rate, sludge feed concentration, solids recovery, and automatic operation, are discussed.

D125
REST AREA WASTEWATER TREATMENT,

Lord, B. N., and Hughes, G. W.

Public Roads, Vol. 41, No. 2, p 53-57, September, 1977. 1 fig, 2 tab.

In light of the number of rest areas associated with the Interstate Highway System, a study was conducted by the Federal Highway Administration to develop recommendations and guidelines for bringing existing and new rest area sanitary waste water treatment systems into compliance with the Federal Water Pollution Control Act. In the first phase of the two part study, existing treatment systems were surveyed to study types, sizes, operational characteristics, and design parameters of rest area sewage treatment systems; to evaluate the abilities of existing systems to comply with 1977 requirements; and to determine current state requirements for rest area waste water treatment. Discharge of rest area wastes was the preferred method of treatment by state highway agencies. The most common methods of treatment in use at existing rest areas were septic tanks with leach fields or sand filters, oxidation ponds, and extended aeration activated sludge package plants. A regional breakdown of rest area sewage treatment systems which were surveyed is presented. Since federal regulations require that publicly owned treatment facilities meet requirements for secondary treatment for all point source discharges by July 1, 1977, design and operating guidelines and procedures for new facilities, as well as upgrading procedures for existing facilities, were developed in the second phase of the program.

D126

THE EFFECT OF SLUDGE DIGESTION ON VIRUS INFECTIVITY,

Eisenhardt, A., Lund, E., and Nissen, B.

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Denmark,
Department of Veterinary Virology and Immunology.

Water Research, Vol. 11, No. 7, p 579-581, 1977. 3 fig, 12 ref.

Virus inactivation during anaerobic sludge digestion was investigated in laboratory experiments with coxsackievirus B3. A virus suspension was added to an experimental digester which was operated to simulate the operation of a full-scale digester. Three control series including pasteurized sludge, Hank's solution at 32 C, and calf serum at 32 C, were set up at the same virus concentration and pH (7.0). Inactivation rates determined for the four systems over a two-week period indicated that inactivation was fastest in pasteurized sludge. The inactivation rate for Hank's solution was lower than for pasteurized sludge and higher than for calf serum. An increase in temperature from 32 C to 35 C increased the inactivation rate for all four systems. Virus determinations for supernatants of centrifuged sludges indicated that some virus was bound to the sludge, since solids' virus determinations were 1.0 log units higher than supernatants'. Additional studies indicated that inactivation rates were not influenced by the initial virus concentration over a range of 4 log units. It was suggested that virus inactivation was partially controlled by biochemical factors instead of purely biological phenomena.

D127

BALL VALVES OFFER AN ALTERNATIVE FOR PUMP CHECK DUTY,

Jowers, A. B.

Harry Hendon and Associates,
Birmingham, Alabama.

Water and Sewage Works, Vol. 124, No. 11, p 97-98, November, 1977. 1 fig.

A valve on the discharge side of the pump in a sewage treatment plant is normally provided to isolate the pump when it is not in service, to control pumping during start-up and shutdown, and to provide pump-check service in case of pump failure. Changes in fluid velocity within the system can lead to problems associated with water hammer, hydraulic shock, or reverse flow. Problems associated with a cone, check, or metal-seat ball valve normally used for pump-checking have led to the use of rubber-seated ball valves. The rubber ball valves are less costly than cone valves, can provide bubble-tight shutoff in both directions, and are resilient for operation at lower torque. Two applications of the use of rubber-seated ball valves in Tuscaloosa, Alabama, are described. A pump check system is used at the 15.5-mgd waste water treatment plant to prevent primary effluent in the aeration basins from draining back into the wet well. A 30" rubber-seat ball valve is provided for each pump and operated by a low-pressure, hydraulic control system which contains a cylinder operator, a differential pressure switch, and a four-way hydraulic valve circuit. Rapid closure of the valves in the event of an emergency power failure is accomplished by a simultaneous de-energizing of all circuits. Pump check systems at the Love water treatment plant in Tuscaloosa are described.

D128
AWARD WINNING PLANT UTILIZES SPRAY IRRIGATION,

McCarthy, J. M.

Dufresne-Henry Engineering Corporation,
North Springfield, Vermont.

Public Works, Vol. 108, No. 11, p 60-61, November, 1977.

The Dufresne-Henry Engineering Corporation has designed a $2,050,000 waste water treatment and disposal facility for the town of Dover, a small ski resort in Vermont. A $1.3-million tributary system with 9.5 miles of sewers and two lift stations was installed for the spray irrigation/land treatment system. Comminutors and dual oxidation canals followed by clarification and effluent chlorination are used to treat the waste water prior to disposal. A liquid-solids gravity separator with polymer thickening is used to dewater the sludge prior to disposal as fertilizer or at a landfill. Design for the facility required accommodation for large variations in flow on a seasonal basis, as well as on a weekend-weekday basis due to the ski area patronage. Two 18.2-million-gal earthen ponds were constructed to equalize variations in plant volumetric loading and to hold effluent during periods when spray irrigation is not allowed because of saturated ground conditions. Spray irrigation over a 55-acre field is accomplished by a distribution system which consists of 4 miles of 2", 3", and 4" galvanized steel piping supported by 1500 wooden posts. Irrigation during the winter is accomplished by fixed spray heads spaced at 25-ft intervals, while irrigation during the summer is accomplished by rotary spray heads at 50-ft intervals. An effluent application rate of 0.25"/hr is controlled by the pressure and flow rate of the effluent from the spray heads.

D129
TURBINE STANDBY FOR WATER AND SEWAGE PLANTS,

North American Diesel and Gas Turbine Progress, Vol. 43, No. 11, p 33-34, November, 1977.

Standby generator sets have been installed in municipal water and sewage treatment plants to provide adequate power during emergency situations when normal electric power service is interrupted. Solar Turbines International manufactures a range of standby generator sets rated from 900-8600 kW, which are in use at a wide variety of sewage and water treatment facilities in the

United States. Four Solar Centaur-turbine-driven sets rated at 3000 kW have been installed at sewage treatment facilities in West Palm Beach, Florida. Provisions were made in the new facility for a fifth standby unit as the plant's capacity increases. The Centaur turbine consists of a simple-cycle single-shaft engine in a "cold-end-drive" configuration with an 11-stage axial-flow compressor, single annular combustor, and three-stage rotor assembly. The structural steel base of each turbine, gearbox, and generator and of the package's operating systems allows movement of the complete unit in a single lift. The Quincy sewage treatment plant in Illinois has begun using two Saturn turbine-driven 800-kW sets which use low BTU sludge gas as fuel. Solar standby units are also in operation at facilities within the Los Angeles County Sanitation District.

D130
THE STATUS AND FUTURE OF OZONE FOR WATER AND WASTEWATER TREATMENT,

Lacy, W. J., and Rice, R. G.

Office of Research and Development,
United States Environmental Protection Agency,
Washington, District of Columbia.

Industrial Water Engineering, Vol. 14, No. 5, p 14-19, September, 1977.

Current and prospective applications of ozone in water and waste water treatment are described. Although chlorination has been the traditional means of disinfection in sewage treatment, the potential toxic effects of chlorine to aquatic life have led to the consideration of ozone as an alternative. Sewage treatment plants in the United States which have used ozone as of 1977 are listed. The use of ozone in the oxygen-activated sludge process and in the removal of total coliforms, viruses, and dissolved solids is described. Pilot plant studies on the use of ozonation prior to activated carbon adsorption have indicated that ozonation can increase removal of dissolved organic carbon compounds, prolong the life of the carbon bed, and result in odor reduction. Current research into the substitution of ozonation for chlorination in water treatment is discussed. Current industrial applications of ozone are examined for the destruction of cyanides and polychlorinated biphenyls and for the treatment of photoprocessing, military hospital, and power plant cooling waste waters. Future potentials for ozonation in the United States are evaluated.

D131
ENERGY GUZZLING SEWAGE PLANT WILL FUEL ITSELF,

Engineering News-Record, Vol. 199, No. 14, p 70-72, 76, October, 1977. 1 fig.

A $70-million physical-chemical-biological waste water reclamation plant has recently been put into operation in Pacheco, California, by the Central Contra Costa Sanitary District. The facility is designed to treat an average flow of

30 mgd, of which 19 mgd are then recycled to five nearby industries for use as cooling and process water. A 1000-tpd front end resource recovery facility will produce about 605 tpd of refuse-derived fuel, as well as separate out reusable metals and glass. The refuse-derived fuel will be mixed with organic sludge and used to fuel multiple-hearth furnaces which have been modified for pyrolysis. A portion of the resulting combustible gas will be used to run the lime recovery furnace while the rest will be burned in afterburners to produce steam in waste heat boilers for 90-95% of the plant's energy needs. In addition, the recovery operation is expected to save $2,275 per day in lime costs. Before passing to the multiple-hearth furnaces, the sludge is first dewatered in two centrifuges to render a moisture content low enough for autothermic burning of the sludge. Designed by Brown and Caldwell Consulting Engineers of Walnut Creek, California, the plant is expected to more than pay back its high initial cost in fuel savings.

D132
EXPANSION PROGRAM GIVEN "GO AHEAD" IN ABSENCE OF FEDERAL FUNDS,

Williams, T. C.

Williams and Works,
Grand Rapids, Michigan.

Water and Wastes Engineering, Vol. 14, No. 10, p 33, 35-37, October, 1977. 1 fig.

With the discovery of oil and the construction of a multi-million-dollar refinery in Kalkaska, Michigan, a rapid influx of new residents had seriously overloaded water and waste treatment facilities. Additions to the existing waste treatment system which consisted of a stabilization lagoon with provisions for seepage and semi-annual discharge to the Boardman River had been prohibited by the State Department of Natural Resources. The ban was later lifted after the installation of aerators, on the condition that Kalkaska would initiate a project to alleviate the overloading. Since federal funds were not available to Kalkaska's low priority project, the city council voted to initiate a $1.3-million program to expand water and sewer systems without grant assistance. The Farmers Home Administration provided funds for local bonds to finance the project. The water system expansion included construction of a new 700-gpm well; a 250,000-gal elevated storage tank; and approximately 4 miles of distribution mains. Expansions for waste water collection and treatment included construction of additional stabilization ponds, irrigation areas to eliminate the need for a direct discharge to the Boardman River, and approximately 4 miles of collection sewers.

D133
WATER CONSERVATION PROBLEMS IN NORTHERN ITALY,

Cenerini, R.

Bologna Environmental Agency,
Bologna, Italy.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2118-2128, October, 1977. 8 fig, 1 tab, 8 ref.

The decreasing availability of conventional water resources in the Emilia-Romagna region of northern Italy and the high cost of water desalination have led to the examination of waste water treatment and water reuse in the region. Twelve waste water treatment plants are currently in operation in Emilia-Romagna's tourist area along the Adriatic coast. The current treatment capacity of 700,000 inhabitants will be increased to serve a total population of 1,100,000 with expansion of existing plants and construction of new facilities. Final disposal of municipal sludge presents a problem, since most plants are located in densely populated areas and landfilling is limited because of ground water pollution risks. Many of the plants have constructed solid refuse incinerators for municipal garbage, and incineration is being investigated as a means of sludge disposal. The city of Bologna has particularly serious problems with water and waste water treatment because the Reno River which serves the city has a very low flow of 4 cu m/sec during the summer. The city's sewer system carries combined municipal, industrial, and storm waste water to a treatment plant which currently serves 450,000 inhabitants and will eventually serve 900,000 inhabitants. Treatment at the plant involves primary sedimentation, activated sludge processes, final sedimentation, chlorination of the treated effluent with ClO2, and centrifugation and incineration of the sludge. Industrial waste practices used in the area are described.

D134
SLUDGE COMPOSTING PROJECTS IN U. S. CITIES,

Epstein, E.

Biological Waste Management and Soil Nitrogen Laboratory,
Agricultural Environmental Quality Institute,
Beltsville Agricultural Research Center,
Beltsville, Maryland.

Compost Science, Vol. 18, No. 5, p 5-7, September/October, 1977.

Recent legislative action, increased public awareness of waste recycling, improved technology, and increased costs of sludge disposal by incineration have led to increased interest in sewage sludge composting in the United States. Current sludge composting methods used in the United States include the windrow system and the Beltsville Aerated Pile Method. In the Beltsville process a mixture of sewage sludge and bulking material such as wood chips is composted in a stationary pile for 21 days while air is drawn through the pile. Design details of a Beltsville composting system used at the Beltsville Agricultural Research Center in Maryland are presented. An extended modification of the aerated pile was developed to reduce the compost area, the amount of blanket material required, and the woodchip requirement for the pile base. Additional studies are being conducted to examine the effects of pile height on composting processes, the feasibility of indoor composting, and possible uses for compost. Among cities in the United States which are now using or have used some type of composting for treatment of sludge are Durham, North Carolina; Bangor, Maine; Camden, New Jersey; Merrimac, New Hampshire; and Chicago, Illinois. Full-scale facilities for composting of 120 tons of wet sludge per day are currently under construction in Windsor, Ontario, Canada.

D135

IRRADIATING DRIED SLUDGE COULD BENEFIT ENVIRONMENT, SAVE ENERGY,

Design News, Vol. 33, No. 19, p 42, October, 1977.

Sandia Laboratories in Albuquerque, New Mexico, has designed a pilot facility to examine the economic and scientific aspects of treating dried sewage sludge with gamma radiation as a means of disinfecting sludge for use as a fertilizer or soil conditioner. The facility which is being built for ERDA will handle dried sludge on a continuous, flow-through basis rather than on a batch system operation. From 30 to 60 lbs of dried sludge will be placed in each of a series of conveyor-suspended buckets. The 10" high, 12" wide, and 24" long buckets will pass over and under a gamma-radiation source of one megacurie of cesium-137, a waste product of nuclear power reactors. Twenty sludge-filled buckets can occupy the radiation zone at any given time, and the radiation dosages can be varied from a few thousand rads up to several million rads by adjustments of the conveyor belt speed. The method of treatment is suggested as an effective means of disinfection which would also put to beneficial use considerable amounts of cesium-137.

D136

SLUDGE DISPOSAL TO LAND 'GOOD FARMING PRACTICE',

Surveyor, Vol. 150, No. 4447, p 22, September, 1977. 1 tab.

Details of a report by the British National Water Council's working party on the disposal of sewage sludge to land are presented. The report concluded that, in general, land application of sewage sludge for agricultural purposes was advantageous because of the large quantities of nutrients, particularly nitrogen and phosphorus, present in municipal sludge. Tentative guidelines on application rates to produce maximum agricultural benefits and minimum deleterious effects are presented. Accumulation of heavy metals in plants as a result of sewage sludge application is discussed. Provisional limits for Zn, Cu, Ni, Cr, Cd, Pb, Hg, Md, B, As, and Se in sludge and possible sources are listed in tabular form. The effects of sludge properties on its adaptability to land application are discussed. Further areas of research recommended by the working party include a literature survey, data collections on the quantity and quality of sludges slated for land disposal, studies on the nutrient value and heavy metal concentrations of sludges, analytical techniques for rapid determinations of metals in sludges, and a cost-benefit analysis of land application.

D137
TANK ACCESSORIES IN PLASTIC,

Water and Waste Treatment, Vol. 20, No. 9, p 66, September, 1977.

Armshire-Sherville Plastics Ltd. of Biggleswade, England, has begun using glass reinforced polyester resin in equipment for water and sewage treatment, including settling tank weir plates and scum boards. The glass reinforced plastic possesses the advantages of corrosion resistance, strength, light weight, and stability over the temperature range -50 to 90 C. Armshire-Sherville's special press molding process gives an easily-cleaned, algae-resistant, smooth finish to both sides of the polyester resin and also produces greater rigidity and flexural strength, which allow thinner wall sections and require less material. Air voids are also eliminated in the press molding process. Dimensions available in Armfibre weir plates and scum boards include thicknesses of 4 and 6 mm, a 2-m length, and depths of 200-500 mm.

D138
RECESSED IMPELLER PUMP,

Water and Waste Treatment, Vol. 20, No. 9, p 62, September, 1977.

Durco Europe has produced a new recessed impeller pump for handling solid, stringy, or fibrous slurries or other materials with high concentrations of suspended solids. The chemical process pump can effectively transport particles as large as 7 cm without clogging. The special design of the Mark II pump includes a recessed impeller vane housed in a single-stage casing. The impeller is out of the main flow of the solids, and back vanes control the stuffing box pressure to keep solids out of the critical seal areas. Problems with shaft deflection and radial bearing loads are eliminated and uniform hydraulic radial loads are created by the close clearance symmetrical chamber which houses the recessed impeller. A back pull-out design allows removal of the entire rotating assembly without disturbing the motor, casing, and piping. Available capacities range up to 160 cu m/hr with heads up to 100 m and operation at temperatures ranging from -30 to 250 C.

D139
SANITATION FOR THE DEVELOPING NATIONS,

Compost Science, Vol. 18, No. 5, p 21, September/October, 1977.

Methods of household waste treatment and disposal which are available to developing nations where traditional methods of sewage treatment would otherwise not be feasible are reviewed. The possibilities include bucket toilet collection systems, pit privies, communal latrines, composting toilets, septic tanks, sewage ponds, and aqua privies. Problems with public health dangers from bacteria, viruses, and parasites have led to the development of a new toilet system by the Vietnamese government. The system is actually a "double septic tank" or a double vault toilet in which urine is separated off to soak into the ground and feces are passed to a masonry vault. One of the two units is used while the other is sealed off for a period of 45 days to produce a nutrient-rich, odorless material for use as a fertilizer. A second double vault system developed by Dr. Krisno Nimpuno of Mozambique allows the use of a small amount of flushing water to cleanse the opening. Aerobic decomposition is maintained by a filter of leaves, charcoal, and crushed limestone which lets liquids as well as kitchen garbage soak through the soil. Additional methods for waterless waste treatment and disposal are described.

D140
INCREASE IN STANDBY GENERATION,

Water and Waste Treatment, Vol. 20, No. 9, p 14-15, September, 1977.

Since interruptions in the operation of a sewage pumping station can result in problems at the waste water treatment plant and in possible pollution of the surrounding waterways, standby power generators are coming into more widespread use. Auto Diesels Braby Ltd. has supplied 23 standby power generators to the Thames Water Authority in England as static and mobile sets with power outputs ranging from 20-480 kVA. Automatic operation can be supplied to provide standby power to the pumps within 20 sec of power supply loss. The mobile sets which are being used in situations where power loss is not so critical can be towed to the emergency area and plugged into the main control panel. The static sets are rated to provide the high initial currents required for pump startup, with an alternator frame size chosen for the particular load of the station. Modifications to the existing distribution switchboard and to the busbar connections were made to prevent inadvertent paralleling of the standby generator sets to the main supply.

D141

COMPARISON OF BENCH, PILOT, AND FULL SCALE CARBON ADSORPTION/FILTRATION,

Moss, W. H., and Sebesta, S. J.

Willard F. Schade and Associates, Incorporated,
Cleveland, Ohio.

AIChE Symposium Series, Vol. 73, No. 166, p 78-90, 1977. 9 fig, 6 tab, 9 ref.

The 10-mgd Rocky River waste water treatment plant in Ohio was the site of a study to compare full scale results of a carbon adsorption/filtration process with previous bench and pilot scale studies. Bench scale studies were conducted on a scale of 0.5 gal/min and pilot scale studies on a scale of 50 gal/min. Carbon treatment performance was measured in terms of suspended solids, 5-day BOD, COD, and total phosphorus in the carbon column effluent. In addition to filtration and adsorption performance, hydrogen sulfide production in the column and column pressure loss and backwashing were evaluated for each carbon adsorption/filtration system. Results indicated that bench-scale studies are not a reliable measure of performance on a larger scale and that the carbon adsorption/filtration process was a solids limited process when applied to the treatment of chemically clarified domestic waste water. Surface filtration was the main result of treatment with an 8 x 30 mesh carbon. Adsorption efficiency was reduced by diurnal variations in flow. Hydrogen sulfide formation was effectively suppressed with the addition of sodium nitrate to the carbon filters. Biological activity was cited as the primary cause of high column headloss.

D142

UPFLOW-DOWNFLOW CARBON ADSORPTION,

Strudgeon, G. E.

Zurn Industries, Incorporated,
Enviro-System Division,
Erie, Pennsylvania.

AIChE Symposium Series, Vol. 73, No. 166, p 43-53, 1977. 10 fig, 1 tab, 4 ref.

An upflow-downflow carbon adsorption system developed by the Enviro-Systems Division of Zurn Industries, Inc., of Erie, Pennsylvania, has been chosen by the city of Garland, Texas, for the treatment of combined municipal and industrial wastes. The system includes series-connected columns of activated carbon which were designed to reduce the number of times the carbon must be regenerated by extending the column service cycle. The counter-current, two-bed system is arranged so that one of the beds acts as a roughing upflow primary contactor, while the other acts as a secondary downflow polishing contactor. When the effluent quality has deteriorated to a predetermined level, the spent carbon from the secondary unit replaces the carbon in the primary unit to maximize carbon utilization. In the series operation, loadings of 0.6-0.7 lbs

COD/lb carbon are possible as compared to loading rates of 0.3-0.4 lbs COD/lb carbon under parallel conditions. Costs and expected treatment efficiency are presented for a 30-mgd plant which uses lime clarification prior to activated carbon adsorption. Carbon adsorption facilities at the 30-mgd Duck Creek sewage treatment plant in Garland, Texas, will include twenty 25-ft diam columns. Carbon replacement will be required approximately every 2-4 days with regeneration in a multiple hearth furnace.

D143

GREYWATER FOR THE GREENHOUSE,

Rockefeller, A., and Lindstrom, C.

Clivus Multrum,
Cambridge, Massachusetts.

Compost Science, Vol. 18, No. 5, p 22-25, September/October, 1977.

Kitchen and toilet wastes can be separated from other household wastes to yield "greywater," which is easier to treat than combined wastes and can be used for other purposes. A closed cycle of organic waste conversion/water purification/food production consisting of a Clivus Multrum, a Lindstrom roughing filter, and a lean-to greenhouse is described. Kitchen and toilet wastes in the Clivus are converted to a humus soil for the greenhouse growing beds. The stone roughing filter is used to treat household waste water for pumping into the 4- x 2-ft greenhouse soil boxes. The relatively stable and warm temperature in the greenhouse, along with the nutrient uptake by the plants, affords favorable conditions for the activity of decomposing organisms and for the purification of household waste waters. Since the amount of water introduced to the greenhouse beds is considerably more than the amount that the plants can transpirate, waste water application is actually more of a hybrid between standard subsurface irrigation and hydroponics. At the test site in Cambridge, Massachusetts, waste heat from a central gas furnace is used as a back-up heat source for the greenhouse. Crushed rock under the concrete slab floor and the warm greywater also help maintain constant temperatures in the greenhouse.

D144
WASTEWATER RENOVATION AND SLUDGE UTILIZATION ON LAND INCLUDING QUESTIONS OF OWNERSHIP,

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Office of Research and Development,
United States Environmental Protection Agency,
Chicago, Illinois.

Compost Science, Vol. 18, No. 5, p 8-15, September/October, 1977. 3 fig, 6 tab, 16 ref.

Land application of municipal waste water as a means of treatment and disposal has been cited as a cost-effective, environmentally sound alternative to the construction of new or improved waste water treatment facilities. Various aspects of land renovation of waste water and application of sludge are discussed, and the feasibilities of public vs. private ownership are examined. Sludge and waste water characteristics are discussed with respect to land requirements. Advantages and disadvantages of public vs. private ownership of land and operation are presented. The Muskegon County, Michigan, waste water treatment system is presented as an example of a publicly owned and operated treatment system which uses land application for the treatment of waste water. The Cooperative Sewage Utilization Association for the treatment and land application of municipal waste water from the city of Braunschweig, Germany, is described as a joint public-private interest. The Fulton County, Illinois, public operation for the treatment of liquid sludges from the Metropolitan Sanitary District of Chicago is described. The public-private land application of sludge in West Hertfordshire, England, is discussed. Research on land application and uses of sludge and waste water are described.

D145
ELASTOMERIC MEMBRANES,

Noble, E. R.

Dunlop Limited,
GRG Division,
Skelmersdale, Lancastershire, England.

Water Services, Vol. 81, No. 978, p 481-483, August, 1977.

Applications of elastomeric membranes to water and waste treatment are described. Membranes have been used in effluent management to contain waste water for subsequent treatment or removal, as well as to line dumping sites or landfills for prevention of underground contamination by surface seepage. One use in India involved the lining of an irrigation canal. Natural rubber membranes have been used to reduce water loss from cracked concrete reservoirs. Common elastomeric membrane materials include Butyl, EPDM, chlorosulfonated polyethylene, and nitrile PVC. Butyl, the first synthetic rubber material offered commercially, is highly impermeable and offers a great deal of chemical resistance. EPDM (Ethylene propylene diene monomer) has a slightly higher resistance to high temperatures and ultraviolet radiation. Chlorosulfonated polyethylene (TM Hypalon) is coming into more widespread use because of its lower temperature tolerance and ease of fabrication. Nitrile PVC offers resistance to prolonged contact with hydrocarbon solvents.

D146

WATER RECLAMATION AND REUSE,

English, J. N.

United States Environmental Protection Agency,
Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 49, No. 6, p 1078-1087, June, 1977. 128 ref.

Various literature pertaining to waste water reclamation and reuse is reviewed. Water resources planning and management practices which incorporate reuse are described. Experiences with the use of municipal waste water and organic wastes for irrigation, fertilization, and groundwater recharge are discussed with respect to costs and effects. Models to assess the reuse of waste water for artificial recharge and to prevent salt water intrusion into coastal aquifers are described. The use of municipal waste water for industrial purposes is examined. In-plant recycling and closed-loop systems for process waste water are reviewed for various industrial applications. Renovation of waste water to augment potable water supplies and the associated health effects are discussed. Recent technology developments in waste water reclamation are described.

D147

ACTIVATED SLUDGE TREATMENT, GENERATION, AND DISPOSAL,

Dick, R. I.

AIChE Symposium Series, Vol. 73, No. 167, p 66-77, 1977. 2 fig, 61 ref.

Various aspects of the activated sludge process in waste water treatment are reviewed. Mathematical expressions for the amount of excess activated sludge produced at a waste water treatment plant are presented. The chemical, biological, and physical properties of waste activated sludge which may influence selection of treatment and disposal techniques are discussed. Previous studies on the treatment of waste activated sludge in combination with other sludges at a waste water treatment plant are reviewed. Reclamation of valuable substances in sludge is discussed with respect to food processing wastes, the production of animal feed supplements from municipal wastes, and the use of processed activated sludge for various agricultural purposes. Since sludge constituents which are not recycled must be returned to some sector of the environment, the effects of sludge disposal on water, air, and land are discussed. Legislation and technology related to sludge disposal practices are described. Sludge thickening, stabilization, conditioning, and dewatering methods are reviewed.

D148

ADVANCED WASTEWATER TREATMENT PROCESSES AT COLESHILL,

Clough, F.

Howard Humphreys and Sons, Consulting Engineers,
Leatherhead, Surrey, England.

Chemistry and Industry, Vol. 20, p 811-816, 1977. 2 ref.

The advanced waste water treatment facilities in Coleshill, England, contain two complete treatment streams, each capable of handling average flows of 450 cu m/day with peaks of 1350 cu m/day for a total population equivalent of 5,000. One of the treatment streams was used in an evaluation of conventional physicochemical treatment with lime addition, settling, first stage recarbonation, settling, second stage recarbonation, media filtration, and activated carbon treatment. The evaluation was conducted to provide information on costs for individual and combination processes. A major advantage of lime addition is greater removal of suspended solids and BOD to reduce settling costs, although the quantity of sludge is increased and costs are incurred by the need for chemical storage and dosing facilities. When lime has been added, two-stage recarbonation is required to adjust the pH prior to activated carbon treatment. Because of its regenerating capacities, granular instead of powdered carbon is used in the activated carbon stage at Coleshill. Properties of activated carbon and operation and maintenance of the adsorption columns are described. The media filtration plant at Coleshill includes three anthracite-sand-gravel filters which can be used singly or in combination. The activated carbon plant includes three pairs of adsorption columns, sewage pumping and backwash equipment, and carbon storage facilities.

D149

PURIFICATION OF MUNICIPAL WASTE WATER WITH ACTIVATED CARBON AFTER WEAKLY LOADED BIOLOGICAL TREATMENT AND FILTRATION (Reinigung von kommunalem Abwasser mittels Aktivokhle nach schwach belasteter biologischer Reinigung und Filtration),

Roberts, P., Gujer, W., and Eugster, J.

Eidgoenossische Anstalt fuer Wasserversorgung Abwasser-reinigung und Gewaesserschutz, Duebendorf, West Germany.

Vom Wasser, Vol. 48, p 47-70, 1977. 13 fig, 9 tab, 9 ref.

Advanced treatment of municipal waste water is often required in Switzerland for compliance with water quality standards on dissolved organic carbon levels in effluents. The effects of operating parameters, including the brand of activated carbon, grain size, and filtration rate, on the fixed bed adsorption were investigated in pilot-scale studies. Additional parameters observed during the studies included activated carbon capacity, concentration profiles, and adsorption performance. The degree of biodegradation of organic compounds during activated carbon treatment was evaluated with respect to the oxygen consumption in the carbon bed. Gas chromatography was used to examine the removal of specific organic substances by adsorption onto activated carbon.

D150

OXIDATION PROCESSES IN ACTIVATED SLUDGE AT HIGH DISSOLVED OXYGEN CONCENTRATIONS,

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 340-354, 1977. 4 fig, 4 tab, 18 ref, 1 append.

Pilot plant studies at the Davyhulme sewage treatment plant in England were used to examine the mechanisms of oxidation in the activated sludge process at high dissolved oxygen concentrations (up to 15 mg/liter). The objective of the study, conducted by the North West Water Authority, was to evaluate the oxygen-activated sludge system for nitrification, process variants, and performance. Operational and design data for the pilot facilities are discussed, including: pilot-plant equipment and operation procedures; staged oxygenation system; completely-mixed activated sludge system; final settling tanks and return activated sludge system; surplus sludge disposal; oxygen/air comparative tests; and monitoring equipment and testing procedures. Studies with municipal and combined municipal/industrial wastes indicated that the performance of the completely mixed reactor with gas stripping pretreatment at uniform mixed liquor DO concentrations of 10 mg/liter was comparable to the liquid staged reactor. Nitrification was achieved with the use of the oxygenation system, with best results occurring when sodium hydroxide was used to maintain the pH/alkalinity within a 7.3-8.0 range. Better overall performance in the treatment of combined wastes was observed during use of the reactor at DO concentrations of 10 mg/liter than with conventional air concentrations of 1-2 mg/liter. Surplus sludge production was reduced by as much as 40% by the high dissolved oxygen concentrations the reactor.

D151

RECENT ADVANCES IN SEWAGE EFFLUENT DENITRIFICATION: PART I,

Cooper, P. F., Drew, E. A., Bailey, D. A., and Thomas, E. V.

Water Research Centre, Stevenage Laboratory,
Stevenage, United Kingdom.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 287-300, 1977. 8 fig, 6 tab, 17 ref.

Results of an investigation by the Water Research Centre in England on denitrification in sewage treatment are presented. A modified activated sludge system with four compartments connected in series was used in studies to compare nitrogen removal by conventional activated sludge processes and by a modified activated sludge unit. The differences in removal of BOD, COD, and organic carbon between the two systems were insignificant. Nitrogen removal for the modified unit was 58-88% as compared with 35-45% for the conventional unit. Large-scale testing of the modified process was conducted at the Rye Meads sewage treatment works. An anaerobic zone was created in the first of four units with a four-pass plug-flow diffused-air activated sludge treatment unit. Total nitrogen was successfully reduced from 40.4 mg/liter to 21.2 mg/liter. Three additional units were connected in series. Performance of the individual units is compared in terms of reductions in ammonia and oxidized nitrogen. The percentage reduction of oxidized nitrogen was 47.7% for the first unit, 48.5% for the second unit, 52.9% for the third, and 53.7% for the fourth.

D152

LISNASKEA SEWAGE-TREATMENT WORKS,

Sanderson, W. I. D.

Kirk, McClure and Morton, Consulting Engineers,
Belfast, Ireland.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 332-339, 1977. 1 fig, 3 tab, 2 ref, 1 append.

The Lisnaskea sewage treatment facility in County Fermanagh in Ireland is described. The system treats combined municipal and industrial wastes for a design population equivalent of 8,000. Treatment at the Lisnaskea plant includes a double stage pretreatment system with interstage sedimentation with Flocor towers to reduce the influent BOD concentration from a maximum of 1,500 mg/liter to a maximum of 300 mg/liter. Treatment of domestic sewage which may contain storm water includes grit removal with a Pista grit trap. The pretreated combined industrial and municipal wastes are pumped to the activated sludge plant by means of three centrifugal pumps. Pre-aeration mixing tanks are used to minimize the effect of shock loadings from dairy effluent. The main aeration tanks for combined wastes are serviced by a fine-bubble diffused-air system. Aerated effluent is transferred to secondary sedimentation tanks and then to tertiary upflow clarifiers. Aerobic digestion tanks are used to treat surplus sludge from the activated sludge plant. Sludge from the aerobic digestion tanks is settled in sludge consolidation tanks and piped to one of four drying beds. The BOD of domestic sewage is reduced in the final effluent from 254.9 mg/liter to 9.7 mg/liter, and the suspended solids from 222.4 mg/liter to 11.9 mg/liter. The industrial effluent pretreatment plant reduces influent BOD from 1,116 mg/liter to a concentration of 286 mg/liter in the effuent. Suspended solids are reduced from 439 mg/liter to 63 mg/liter.

D153

LOAD BALANCING AT SEWAGE-TREATMENT WORKS: THE SOUTHAMPTON UNIVERSITY PILOT PLANT AT MILLBROOK,

Helliwell, P. R., and Reed, R. J. R.

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United Kingdom,
Department of Civil Engineering.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 355-372, 1977. 14 fig, 2 tab, 10 ref.

Load balancing in sewage treatment was investigated with a 45.4-cu-m/day pilot plant at Southampton University in Millbrook, England. The design of the pilot plant follows that of a conventional treatment plant with a diffused-air activated sludge system with the addition of an off-line balancing tank. Design data is presented for the primary sedimentation tank, activated sludge thickening tank, off-line balancing tank, aeration tank, and construction and materials. Control systems which are described include: load balancing control, influent flow control, level control, instrumentation, fail-safe arrangements, and the reactivated sludge rate. Measurements for organic strength are described. Aspects of process kinetics which are discussed include: steady and variable flow rates, steady and variable concentration, steady and variable load, the plug flow reactor, and the continuous stirred tank reactor. The effects of load balancing on flow, BOD, and load variations in primary and final effluents are discussed. A flow diagram for a computer program to regulate operations of a load balancing system is presented.

D154

BIOLOGICAL DECOMPOSITION OF REFRACTIVE COMPOUNDS AFTER CHEMICAL OXIDATION (Biologischer Abbau refraktaerer Verbindung nach chemischer Oxidation),

Janicke, W.

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Berlin, West Germany.

Gesundheits-Ingenieur, Vol. 98, No. 7/8, p 208-212, 1977. 2 fig, 71 ref.

The chemical oxidation of stable tensides, such as tetrapropylenebenzenesulfonate (TBS) and nonylphenolethoxylate (NPE) by chlorination and ozonation, and its effect on the efficiency of the subsequent biological waste water treatment were studied under laboratory conditions. The tenside concentration in the water was about 4.8 g/liter for ozonation for 2.5 or 8 hrs. The flow rate of the ozone-containing oxygen was about 200 liters/hr for TBS, and 80-100 liters/hr for NPE. The pH was maintained at the neutral point. Chlorination was performed at 10 C with a weak chlorine gas current for 5 hr, or with chlorinated water for 30 min. Ozone had only slight effect on TBS and on the subsequent biological treatment, while it oxidized NPE effectively and increased the efficiency of the biological treatment by about 100%. Chlorine oxidized NPE more effectively than TBS, but it also increased the efficiency of the biological degradation of the latter.

D155

THE PURIFICATION OF DOMESTIC WASTE WATER BY MEANS OF ACTIVATED CARBON AFTER LOW LOADING BIOLOGICAL TREATMENT AND FILTRATION (Reinigung von kommunalem Abwasser mittels Aktivkohle nach schwach belasteter bioligischer Reinigung und Filtration),

Roberts, P., Gujer, W., and Eugster, J.

Eidgenoessische Anstalt fuer Wasserversorgung Abwasserreinigung
und Gewaesserschutz (EAWAG),
Duebendorf, West Germany.

Vom Wasser, Vol. 48, p 47-70, 1977. 13 fig, 9 tab, 9 ref.

In some instances, Switzerland's strict effluent standards necessitate advanced treatment to remove dissolved organic carbon from municipal waste water. Pilot-scale studies were used to examine the effect of operating parameters, including the brand of activated carbon, grain size, and filtration rate, on fixed bed adsorption processes. The experiments examined adsorption performance, concentration profiles, and activated carbon capacity. Data for oxygen consumption in the activated carbon bed were used to estimate the degree of biological degradation of organic compounds. Gas chromatography was used to study the removal of specific organic compounds.

D156

REMOVAL OF UNCOMMON TRACE METALS BY PHYSICAL AND CHEMICAL TREATMENT PROCESSES,

Hannah, S. A., Jelus, M., and Cohen, J. M.

Chemical Treatment Section, Wastewater Research Division,
Municipal Environmental Research Laboratory,
Environmental Protection Agency,
Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2297-2309, November, 1977. 3 fig, 9 tab, 36 ref.

Measurable concentrations of various trace metals which are toxic at even low concentrations can be found in domestic waste waters. Studies have been conducted to evaluate the capability of physical-chemical processes in municipal waste water treatment for removing these metals. A research project at the EPA Environmental Research Center in Cincinnati, Ohio, utilized a 4 gpm continuous-flow pilot plant which received raw waste water from a residential suburb of the city. The plant included a rapid mix flocculator, settler with sludge storage tank, dual-media filter with backwash collection tank, and two parallel carbon adsorption systems. The raw waste water was dosed with salts of 11 uncommon trace elements, including: Ag, Be, Bi, Co, Mo, Sb, Se, Sn, Ti, Tl, and V. Metal removals by each unit process were calculated. The system was operated to provide optimum removals of suspended solids and organics rather than metals. The system was tested with three different coagulants, including lime, ferric chloride, and alum, and the metal removal efficiencies were compared. The data indicated that, with the exception of Sb and Mo, one or more of the coagulants were capable of achieving metal removals of more than 90%. For the lime system 90% removals were not achieved for Mo, Sb, and Se. In the ferric chloride system 90% removal did not occur for Co, Tl, Mo, Sb, and Se. Chemical clarification with alum removed less than 90% of Mo, Tl, Zn, Mn, Ni, Co, Cd, Sb, and Se.

D157

QUARTERNARY AMMONIUM THICKENING OF SEWAGE SLUDGE IN MAGNETIC FIELD,

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Stevens Institute of Technology,
Hoboken, New Jersey,
Department of Mechanical Engineering.

Industrial and Engineering Chemistry Product Research and Development, Vol. 16, No. 4, p 311-315, December, 1977. 3 tab, 24 ref.

Since sludge handling and disposal costs comprise approximately 40% of the total cost of the activated sludge process of waste treatment, much research has been conducted in the fields of sludge thickening and volume reduction. A sludge dewatering method, involving simultaneous settling and thickening of nonmagnetic sludge by magnetic fields, is described. The technique involves chemical addition, flocculation, polarization, sedimentation, and disinfection. The process is based on the addition of finely divided iron oxide particles to the sewage sludge as both the weighing agent and the polarization-inducing agent prior to the addition of a coagulant and floc formation. The agglomerates which contain sludge solids, iron oxide, and a quarternary ammonium compound are then flocculated and passed through a magnetic field for further polarization to yield very high weight-to-surface-area floc particles. The high specific gravity of the condensed flocs results in rapid settling without the need for secondary flocculation. The addition of a quarternary ammonium compound also disinfects the settled sludge and supernatant.

D158

APPLICATION OF PHOTODYNAMIC OXIDATION TO THE DISINFECTION OF TAPWATER, SEAWATER, AND SEWAGE CONTAMINATED WITH POLIOVIRUS,

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Houston, Texas,
Department of Virology and Epidemiology.

Photochemistry and Photobiology, Vol. 26, No. 5, p 499-504, 1977. 5 fig, 2 tab, 20 ref.

The prevalence of enteroviruses in chlorinated waste water effluents presents a major obstacle to waste water reuse. Photoreactive dyes have already been used to inactivate microorganisms in a variety of medical applications. Laboratory studies have indicated that exposure to methylene blue dye and visible light can result in photoinactivation of poliovirus in tapwater, sewage, and seawater. Exposure of poliovirus type 2 to 670 nm light in solutions containing 5 ppm methylene blue at pH 10.0 resulted in an average virus reduction of 2.5 logs. A multi-hit inactivation event was suggested by the biphasic inactivation curve produced regardless of dye concentration, pH, temperature, sensitization time, nature of suspending solution, or sequence of light exposure. The rate of virus photoinactivation was increased by pre-incubation of the dye-virus mixture at 24 C. Increasing dye concentrations above 10 ppm did not significantly enhance photoinactivation. In the absence of visible light, high dye concentrations in the range of 20-45 ppm did result in significant inactivation of poliovirus. Alternating light and dark periods did not significantly affect inactivation. The use of natural light sources for dye-sensitized photoinactivation is suggested as a means of reducing disinfection costs.

D159
MAKING OPTIMUM USE OF FILTER MEDIA IN WASTEWATER FILTRATION,

Maxwell, M. J., Work, S. W., Linstedt, K. D., and Bennett, E. R.

Black and Veatch Consulting Engineers,
Denver, Colorado.

Water and Sewage Works, Vol. 124, No. 12, p 56-61, December, 1977. 9 fig, 3 tab, 19 ref.

A two-phase pilot plant investigation was used to examine the effects of chemical pretreatment and the depth and composition of the filter media on filter performance in waste water treatment. Activated sludge effluent was obtained from the Metropolitan Denver waste water treatment plant and used in studies on filtration of secondary effluent and alum-coagulated secondary effluent with and without settling prior to filtration. Components of the pilot system included: a head tank, rate control valves, pre-sedimentation tank for minimizing influent solids variations, on-line alum injection, flocculation tank, clarifier, polymer feed, filters, and an on-line turbidimeter. Various bed depths of coal, sand, and garnet were employed in the study. The filters were operated in three modes: standard clarification, high rate clarification, and plain filtration. Filtrates were analyzed for BOD, COD, suspended solids, total phosphorus, and total and fecal coliforms. Plain filtration was capable of reducing suspended solids levels in the effluent to 1-2 mg/liter over filter runs in excess of 20 hr at 6 gpm/sq ft. Although coagulation with alum and polymer addition produced a high quality effluent, rapid head loss developed because of the high solids loading and relatively weak chemical floc. In mixed media filters, the coarser coal layer was responsible for removal of most of the floc solids. The finer sand and sand-garnet media were responsible for solids retention in the high rate system. Mixed media filters were more effective than dual media filters in the high rate and standard clarification systems, although this difference was not apparent during plain filtration.

D160
BIOLOGICAL NITROGEN CONTROL IN THE ACTIVATED SLUDGE PLANT (Gesuishori shisetsu ni okeru chisso jokyo ni kansuru kenkyu),

Ando, S., Kobrio, K., and Yagibashi, I.

Showa 5I nendo kankyo hozen kenkyu seika shu, No. II, Vol. I., No. 97, p 1-28, 1977. 37 fig, 9 tab, 18 ref.

Studies were conducted to determine the physical, chemical and biological conditions required for effective nitrification in the conventional activated sludge process. Other objectives of the studies included the definition of optimum operating conditions for nitrification and organic removal at existing sewage treatment plants and the development of recovery techniques for organic carbon as a source of carbon for the denitrification process from anaerobic digester supernatant. Studies on the effects of sludge retention time (SRT) on nitrification revealed that the distribution of organisms in activated sludge was controlled by the SRT. At a temperature of 20 C in a mixed culture system, an SRT of 7.4 hr was required for generation of ammonium oxidizers, 11.6 hr for nitrite oxidizers, 2.5 days for activated sludge ciliates, 3.5 days for Rotifera, and 13.6 days for Sarcodina. The optimum pH for nitrification was 8.0, with shock to the system due to organic loading becoming severe at lower pH values. A nitrifier concentration of 10,000 N/ml was required to maintain nitrates in the effluent. SRT's of 11, 6, and 3 days are required for effective nitrification at pH's of 6, 7, and 8, respectively. Studies on the effects of trace inorganics indicated that the presence of magnesium and phosphates accelerated nitrification. High dosages of nitrate, fluoride, sulfate, iodide, bromide, and chloride ions slowed nitrification rates in the presence of phosphate.

D161

AEROBIC DIGESTION OF SEWAGE LIME SLUDGE,

Tsai, K-C.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2323, 1977.

Laboratory studies were conducted to establish design and operational criteria for aerobic digestion of lime sewage sludge generated during phosphorus precipitation in a primary clarifier. Batch and semi-continuous flow reactors were operated at temperatures of 10, 20, and 30 C. Parameters used in the evaluation of optimal process design and control included: detention time, oxygen uptake rate, volatile suspended solids destruction, liquid sludge COD reduction, supernatant COD and phosphorus contents, sludge settleability and dewaterability, and potential phosphorus release. The studies indicated that lime sludges having an initial pH as high as 11.0 are aerobically digestible in the presence of appropriate microorganisms. An optimal sludge retention time of 10 days and an air flow of 60 scfm/1000 cu ft of digester volume were suggested for a semi-continuous flow unit operating at 20 C. A dissolved oxygen concentration of 1-2 mg/liter and a pH above 7.0 are recommended to minimize potential phosphorus release from the sludge to the liquid phase. The sludge was easily settled and dewaterability was improved significantly by digestion.

D162
A LOOK AT NEWER METHODS FOR DEWATERING SEWAGE SLUDGES,

Villiers, R. V., and Farrell, J. B.

Ultimate Disposal Section, Municipal Environmental Research Lab,
Environmental Protection Agency,
Cincinnati, Ohio.

Civil Engineering-ASCE, Vol. 47, No. 12, p 66-71, December, 1977. 9 fig, 4 tab, 11 ref.

Although incineration has been widely used as a sludge disposal technique, high fuel costs have begun to render the process uneconomical unless the sludge can first be dewatered to a solids concentration of greater than 30%. This value is critical, since the sludge will burn autogenously above a solids concentration of 30%. Although vacuum filtration and centrifugation can dewater sludge to about 20% solids, the amount of auxiliary fuel required for incineration is still considerable. The Klein belt filter press was developed in Europe in the early 1960's and first introduced into the United States in 1971. Pilot studies at the Allegheny County waste water treatment plant in Pittsburgh, Pennsylvania, have indicated that the belt filter press is capable of producing a sludge cake of 30% solids or greater, 5-12% higher than expected with a vacuum filter. Other filter presses which have achieved solids concentrations as high as 44% include a twin roller press, a high-solids filter, screw presses, and diaphragm filter presses. Design data and operating experiences are presented for various commercially available filter presses.

D163
FIBRE MATS FOR LANDSCAPE ENGINEERING,

Waste and Waste Treatment, Vol. 20, No. 8, p 24, August, 1977.

Enka Glanzstoff of Germany has developed a series nylon fiber mats for use in erosion control, riverbed linings, and sewage system canals, and for a variety of landscaping applications. The Enkamat technical mats consist of several layers of looped, nylon-6 threads in a bulky three-dimensional mat that can be filled with soil, sand or gravel. The mats exert a braking effect on surface water and winds and stabilize the loose or granular material which they contain. Water permeability is increased and root growth promoted to enhance the load-bearing capacity of the soil. Enkamat is available in 10- and 20-mm thicknesses in rolls of 1-m width and 100-150-m length.

D164
CONCRETE STAVE TANKS,

Water and Waste Treatment, Vol. 20, No. 8, p 44, August, 1977.

The "Prestave" line of circular tanks, filter barrels and silos are manufactured by Tower Silos Ltd. for use in liquid storage, biological filters, and chemical storage. The units are constructed of hydraulically-formed high density concrete staves which are prestressed with external high strength steel hoops during erection. The 760-mm long by 320-mm wide staves are available in thicknesses of 64 and 76 mm. Filter barrel capacities range up to 4,000 cu m with diameters of 3.04-26 m. Silo capacities range up to 1,500 cu m with diameters of 3-30 m and heights up to 30 m. Storage tank capacities range up to 1,400 cu m with heights up to 9.15 m and diameters of 3.04-18.3 m. Specialized linings which are suitable to various applications are available. Auxiliary equipment can be supported on the top of the tank or along the walls of the tank itself, presenting an advantage in biological filtration with conventional stone or plastic media.

D165
COMPLETE SERVICE FOR SLURRY RECYCLING,

Water and Waste Treatment, Vol. 20, No. 8, p 44, August, 1977.

Molex Limited produces a complete system for land disposal of digested sludge as a fertilizer and soil conditioner. Used in England, the method has provided a viable method of sludge disposal which also returns essential nutrients to the land. Much of the sludge transportation is accomplished by Molex road tankers with capacities ranging 1,500-4,600 gallons. A Molex HD 130/100 screw pump is used to convey the load to a 4,600 GRP Molex transfer vessel. For distribution over farm land, the sludge is pumped to agricultural slurry tankers of the 900-gal fiberglass or 1,200-gal single axle type. The tankers are equipped with flotation tires to minimize soil compaction and maximize the travel range of the road tanker. The screw pump has an output of 22,000 gph at 130 psi and 300 ft head and can be used during foul weather to pump the slurry into irrigation lines with multiple spreaders. The HD 130/100 can also be used as a diesel-driven mobile irrigation unit.

D166
SUBMARINE PIPELINE FOR RIVER WEAR,

Water and Waste Treatment, Vol. 20, No. 8, p 42, August, 1977.

The Northumbrian Water Authority in England has contracted the Engineering Division of John Laing Construction to install a sewage pipeline on the sea floor at Sunderland, Tyne and Wear. The project was initiated in an effort to improve the water quality of the River Wear. It includes an evaluation of the sewage outfall area about one mile south of Hudson Dock and fabrication and installation of 300 m of 1.4 m-diam piping at a total cost of 552,000 lbs. The pipe will be fabricated and joined in lengths of up to 120 m at Hudson Dock. The concrete-coated pipe will be transported to the sea on a steel slide and towed to the outfall site by tug. A pontoon-mounted crane equipped with a mechanical excavating grab will be used to excavate and backfill the pipe trench. The pipeline will be connected to an existing outfall pipe at one end and fitted with a concrete-coated diffuser at the other. Before disposal through the new pipeline, sewage will be screened at the Hendon waste water treatment plant.

D167

GLASS LINED TANKS GAIN POPULARITY,

Water and Waste Treatment, Vol. 20, No. 8, p 20, August, 1977.

Glass-lined tanks have come into use in the water and waste treatment industries and in a variety of industrial applications, including storage facilities for fertilizer, fuel oils, fruit pulp, salt solutions, adhesives, sludge, and chemicals. Tristorage Ltd. of Maidstone, Kent, England, produces a wide range of tanks constructed from pre-drilled and radiused sheets to allow easy transport and construction. A strong glass-to-steel bond and a smooth glass surface are created by a process which involves firing at 845 C. The tanks are resistant to corrosion, designed for storing liquids of a wide pH range, and are available in sizes of 800-373,000 gal. They can be set on steel supports, installed at ground level, or submerged. The prefabricated sheets are manufactured in 4'6" standard heights which are then bolted together. Flat steel roofs, cast aluminum roof hatches, steel ladders, platforms, cages, and handrails are also available as tank accessories from Tristorage. All seams are sealed with a bituminous or polyurethane compound.

D168

REHABILITATION OF FILTER BED WALLS,

Water and Waste Treatment, Vol. 20, No. 8, p 18, August, 1977.

The cracked and collapsing walls of the biological filter at Wessex Water Authority's Bruton sewage works in England were repaired in three days using a patented pre-cast concrete wall unit developed by Jan Brobowski and Partners in conjunction with ECC Quarries Limited. Temperature variations in the area had resulted in expansion of the wall, settling of the media, and cracking of the filter walls as construction was resisted by passive pressure. Post-tensioned cables had been initially wrapped around the walls, but they were not effective in preventing further expansion of the cracks. The number of additional cables required to alleviate the problem was prohibitive and backfilling to minimize temperature fluctuations would have been difficult. The last option under consideration was reconstruction of the filter. The ECC units which were finally installed did not require removal of the existing wall. Cooling contraction within the bolted joints of the ECC units prevents passive resistance failure via thin neoprene washers which absorb temperature movements and transmit ring forces. Steel dowels are grouted into the filter base slab to limit outward movement of the base of the filter wall. At Bruton the new wall was constructed as closely as possible to the existing wall. The remaining space between the two concentric walls was filled with pea-sized gravel to transmit expansion forces.

D169

SEA OUTFALL FOR DORSET,

Water and Waste Treatment, Vol. 20, No. 8, p 38, 42, August, 1977.

Plans for a drainage system and sea outfall have been recently adopted by the Wessex Water Authority in England as a solution to problems associated with seven existing outfalls in the Weymouth and Portland areas. Extensive investigations prior to the development of a final design will evaluate environmental conditions before and after the construction of the proposed outfall. Studies will be conducted to select the most appropriate location and design. The length of the outfall has been tentatively set at 1,200 m. The fate and distribution of sewage bacteria from the outfall site will be assessed. Pretreatment requirements will also be evaluated. The discharge of ground and screened domestic effluents via an outfall was chosen over the more costly option of construction of inland waste water treatment facilities. Concern has been voiced over possible damage to Chesil Beach by the 140-ft deep outfall tunnel. The total cost for sewers, pumping stations, headworks, and the sea outfall is projected at 8,800,000 pounds.

D170

SOIL'S NATURAL PROCESSES CAN CLEAN WASTES FROM SEWAGE WATER,

Crops and Soils Magazine, Vol. 30, No. 2, p 23, November, 1977.

Naturally occurring chemical and biological processes in soils have been recommended for waste water treatment by Clarence Lance of the United States Water Conservation Laboratory in Phoenix, Arizona. The method is suggested, in particular, for the removal of nitrogen and phosphate from waste water with possible applications in the removal of organic material and fecal bacteria from secondary sewage effluent. Studies at the Water Conservation Laboratory used soil-filled pipes as models of a land filtration system. Waste water application rates 20-30 times higher than those used for crop irrigation are considered feasible in renovation of waste water with a high-rate land filtration system.

D171
THE BANGOR PROJECT,

Building Systems Design, Vol. 74, No. 6, p 10-14, October/November, 1977. 1 fig.

Details of a sludge composting project being conducted in Bangor, Maine, by the Office of Solid Waste Management Programs of the United States EPA are presented. Objectives of the Bangor project were to evaluate the effects of bulking agents on sludge, to examine the use of suction aeration for control of odors and pathogens in sludge composting, to survey public opinion on sludge composting, and to identify potential uses for the final product. The approximately 50 cu yds of sludge generated each week in Bangor is hauled to the composting site and mixed with bark waste at a ratio of 3 parts bark to one part sludge. The four 200-cu yd, active aerated compost piles which receive the sludge/bark mixture are equipped with a piping network for suction aeration to provide the necessary oxygen for microbial degradation and stabilization of the sludge. The compost piles are monitored daily for temperature and oxygen content to insure that microorganism requirements are met. Heavy metals, primary nutrients, fecal coliform, Salmonella, and pH are measured quarterly in the sludge and compost. Application of the screened compost is currently limited to non-food chain crops.

D172
COMPOSTING RAW SLUDGE,

Epstein, E., and Willson, G. B.

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Agricultural Research Service,
United States Department of Agriculture,
Beltsville, Maryland.

Building Systems Design, Vol. 74, No. 6, p 14-19, October/November, 1977. 3 fig, 2 tab, 8 ref.

The Agricultural Research Service in Beltsville, Maryland, has developed a composting system for primary and secondary undigested sludge. Earlier unsatisfactory experiences with windrow composting led to the development of the forced aeration system. The raw sludge is first mixed with bark or woodchips to provide bulk. Air is vacuum drawn through the pile while a cover of finely screened compost from previous compost operations prevents odoriferous gases from escaping into the atmosphere. Air suction is applied for a period of 10-14 days and then the cycle is reversed to conduct air into the pile for a period of 7-10 days. The compost is removed from the pile after 21 days and then moved to a stockpile for a 4-week curing period. The woodchips are recovered for reuse when the cured compost is screened. The compost pile is monitored to maintain temperatures of more than 45 C and oxygen levels of 5-15%. Equipment requirements for the forced aeration system are detailed.

Pilot studies on composting of sludge obtained at the Blue Plains Waste Water Treatment Plant in Washington, District of Columbia, are described.

D173

CENTRIFUGE FOR CONCENTRATING ACTIVATED SLUDGE (Concentration centrifuge des boues activees),

La Technique Moderne, Vol. 69, No. 1, p 34, January, 1977. 2 fig.

Advantages of centrifugal thickening of activated sludges include no surcharging of primary clarifiers, reduced water recycling between anaerobic digesters and the treatment plant, better gas production during digestion, and lower energy needs. Screening devices in mechanical thickeners have presented problems. The Celleco Microsorter solves these problems by eliminating all solid particulates at the pre-screening stage. The main components of the system are a self-cleaning screen, the Microsorter, and the FESX 412/512 disk separator, which continuously discharges the concentrate through the nozzles. Gravity separation removes the solids from the apparatus after collection. The system can handle 20-30 cu m/hr of a feed solution containing up to 2% dry solids.

D174

NEW WASTE TREATMENT SYSTEM,

Consulting Engineer, Vol. 49, No. 4, p 122, 124, October, 1977.

Kramer, Chin and Mayo, Inc. of Seattle, Washington, have designed a $2,220,000 waste water treatment system for the city of Monroe, Washington. The project's objectives were to increase Monroe's sewage disposal capacity and quality while providing for anticipated population increases and annexations. The rotating biological contactor system which was supplied by Autotrol Corporation of Milwaukee, Wisconsin, provides both primary and secondary treatment. Three fine screens eliminate settleable solids during primary treatment. In the secondary treatment phase, the screened waste water passes to four 11"-diam biological contactors. Hundreds of polyethylene discs are attached to the steel shaft of each contactor to provide a suitable medium for bacterial growth. The shaft rotates to provide continuous contact between the bacterial growth and waste water nutrients for conversion of the organic matter into carbon dioxide and water.

D175
SLUDGE TOXICITY REDUCED,

Consulting Engineer, Vol. 49, No. 4, p 146, 148, October, 1977.

Zimpro Inc. of Rothschild, Wisconsin, was contracted by the United States EPA and the City of Louisville, Kentucky, for detoxification of a municipal sewer system which had been accidentally contaminated with hexachlorocyclopentadiene and octachlorocyclopentadiene. Preliminary tests by Zimpro indicated that low-pressure wet-air oxidation was capable of producing a 93% reduction in the chemicals. The oxidized sludge was then dewatered and incinerated in a multiple-hearth furnace. Concentrations of hexachlorobenzene, a more stable toxicant, were also reduced substantially by the Zimpro treatment process. Approximately 6 million gallons of contaminated sludge has already been treated in trial runs with Zimpro equipment at the Morris Forman waste water treatment plant in Louisville.

D176
SEWAGE TREATMENT IN THE 1980s,

Stuart, W. J.

Water Services, Vol. 81, No. 978, p 483, 486, August, 1977.

The Spiral "S" aeration system has been developed by the Inka Division of A Johnson Construction Ltd. The system includes a series of internal concentric tanks which are arranged to provide plug flow conditions through the aeration zone. The concentric channels also eliminate problems associated with surface screw and short circuiting of inlet plug flows. Inlet screening, grit removal, aerobic waste sludge treatment, internal settling tanks, and flocculation tanks can be incorporated into the system. The precast concrete tank construction and the process design result in a low overall cost for the system. Spiral "S" aeration tanks are available in sizes for a population range of 4,000-40,000 and can be arranged in parallel according to desired size and loading capacity. The tank elements can be equipped with automatic monitoring devices and can be constructed at the site.

D177
WASTEWATER TREATMENT FOR TEMPORARY CONSTRUCTION CAMPS IN REMOTE LOCATIONS,

Eggener, C. L., and Tomlinson, B. G.

Water and Sewage Works, Vol. 124, No. 11, p 81-83, November, 1977.

Stricter regulations on waste water treatment for temporary construction camps, resorts, and other seasonal facilities have led to the design of a variety of "packaged" physical-chemical waste water treatment systems. The operation, modification, and maintenance of 36 of these systems are reviewed. Waste water treatment needs for construction camps are largely dependent upon the size of the resident population and the work schedule. Typical waste water flows and characteristics are presented. Waste water normally passes via gravity sewers to rotary screens or comminutors and then to an aerated equalization tank where coarse bubble aeration provides complete mixing. Packaged physical-chemical treatment plants generally employ either powdered or granular activated carbon. Waste water flows are usually coagulated with alum and flocculated with an anionic polymer. Rough clarification, multi-media filtration, and chlorination are used to further treat the waste water before it passes to an effluent percolation lagoon. Gravity thickeners and basket centrifuges are used to dewater the remaining sludge prior to incineration. Various modifications which have been made to packaged waste water treatment systems since their inception are described.

D178

CHEMICAL TREATMENT AS A COST-EFFECTIVE ALTERNATIVE FOR WASTEWATER TREATMENT: OPERATING VS. CAPITAL COSTS,

Daniels, S. L., Carmouche, L. N., and Driscoll, E. D.

Dow Chemical U. S. A.,
Midland, Michigan.

AIChE Symposium Series, Vol. 73, No. 166, p 333-343, 1977. 4 fig, 6 tab, 22 ref.

A summary of the technology, availability, environmental impact, and costs of chemical treatment as an alternative to capital expansion is presented for four secondary treatment configurations. The alternatives include: clarification (25% hydraulic overload); clarification and aeration (25% hydraulic overload and 20% organic overload); chemical treatment (flocculation); and chemical treatment (coagulation and flocculation). Since chemical treatment can be integrated with existing facilities to increase plant capacities, it has been suggested as a less costly alternative to the construction of new facilities for compliance with Public Law 92-500. Chemical treatment can also be implemented in 3-12 mos as opposed to the 36-60 mos normally required for capital expansion. However, since most costs associated with chemical treatment are incurred with daily operation and are not covered under federal funds, plant expansion has generally been favored by municipalities. Environmental impact, sludge handling, economics, capital costs, and operating costs are discussed with respect to benefits derived from chemical treatment. Chemical treatment is also described as a means of "interim treatment" for those plants which must go to capital expansion.

D179
POST TREATMENT OF MOST HOSPITAL WASTEWATERS BY OZONATION FOR REUSE,

McNulty, K. J., Goldsmith, R. L., and Gollan, A. Z.

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Abcor, Incorporated,
Cambridge, Massachusetts.

AIChE Symposium Series, Vol. 73, No. 166, p 252-264, 1977. 10 fig, 2 tab, 18 ref.

Laboratory and pilot studies are being used to develop an advanced waste water treatment system for a mobile army field hospital. Design criteria outlined by the U. S. Army Medical Research and Development Command specified that the output capacity of the system be 4,000 gpd. Additional criteria included a waste water recovery capacity in excess of 85%, equipment which fit into two 11.5' x 6.5' x 6.75' containers, a weight not in excess of 6,000 lbs per container, power consumption not in excess of 30 kw, and the capability of treating all types of hospital wastes. A three-step treatment process which included ultrafiltration, reverse osmosis, and ozonation was chosen. Ozonation studies were conducted on reverse osmosis permeates of hospital composite and laboratory wastes. The studies concluded that ozonation of reverse osmosis permeates was required to insure compliance with water quality standards of 5 mg/liter TOC and 10 mg/liter COD. The ozonation reaction rate was at its maximum at intermediate temperatures of 40-50 C for both hospital composite and laboratory waste. The rate of reaction was also more rapid at high pH's. The rate of reaction of ozone with dissolved organics was increased by irradiation with ultraviolet light. The free radical mechanism of ozonation was cited as the cause of these reaction rate effects.

D180
PYROLYZING SEWAGE SLUDGE ALONE MOVES SLOWLY TOWARD MARKET,

Engineering News-Record, Vol. 199, No. 14, p 76, 80, 83, October, 1977.

The pyrolysis of sewage sludge, alone or in combination with refuse-derived fuel, has been investigated because of greater energy recovery and less air pollution than from conventional systems. Nichols Engineering and Research Corporation of Belle Mead, New Jersey, has proposed a plan for the pyrolysis of some 7,500 tons per day of wet sludge from New York City and the adjacent northern New Jersey area. The operation should produce an energy equivalent of $22 million per year of fuel oil at current prices. The need for alternative means of sludge disposal other than off-shore dumping and the prohibitive costs of land disposal led to the selection of on-site disposal. Pyrolysis was chosen over conventional incineration because it would produce less air pollution and could be carried out on a smaller, decentralized basis. Various test programs were conducted on sludges from several New York City plants. A small pyrolysis plant has been installed in Deep Water, New Jersey, for the pyrolysis of 21 tons per day of wet sludge in a partial mode. The Deep Water facility was also designed to regenerate activated carbon for use in the treatment process.

D181

OZONE DISINFECTION AND OXIDATION IN A MODEL OZONE CONTACTING REACTOR,

Perrich, J., McCammon, J., Cronholm, L., Fleishman, M., and Pavoni, J.

Olin Corporation,
Brandenburg, Kentucky.

AIChE Symposium Series, Vol. 73, No. 166, p 225-229, 1977. 5 fig, 5 tab.

A semiflow batch reactor was used in laboratory studies to investigate ozonation mechanisms and rates and to evaluate the use of ozone for the inactivation of poliovirus and E. coli in waste water. Pseudo first-order kinetics were observed during the inactivation studies. The data suggested that there is no threshold ozone dose for viral or bacterial inactivation. Extremely low dose rates of ozone in buffered deionized water, 0.009 and 0.0008 mg O3/liter/min, produced significant inactivation of poliovirus and E. coli. The experimental data also suggested that standard laboratory frits and diffusers may catalytically decompose ozone in the gas phase. The addition of a non-nitrogenous carbonaceous compound in the form of dextrose enhanced virus inactivation. The addition of a nitrogenous carbonaceous compound in the form of alanine had no effect on inactivation. In general, poliovirus was not as susceptible to inactivation by ozone as E. coli. Studies on inactivation mechanisms were inconclusive, although the data suggested that cell wall lysis did not occur in E. coli inactivation by ozonation.

D182

NEW SEWAGE TREATMENT PLANT INSTALLED,

World Dredging and Marine Construction, Vol. 13, No. 12, p 41, November, 1977. 1 fig.

The new physical-chemical sewage treatment system at the Nippon Kokan Tsurumi shipyard in Japan was developed by Zurn Industries, Inc., of Houston, Texas. The system is designed for the treatment of domestic sewage and is available in standard capacities of 200, 400, and 600 cu m/day. When the sewage in a wet well reaches a certain level, it is pumped to a contact chamber where activated carbon is added to adsorb the organic wastes. Flocculation with sulfuric acid and polymer and separation of the solid material in a settling tank comprise the next stage of treatment. The supernatant water is chlorinated and then passed through an upflow filter before recirculation or discharge. The BOD and COD at this point in the treatment process are both less than 10 mg/liter. Although operating costs are approximately 20% higher than those of the conventional activated sludge systems, construction costs are about one-third lower and the system is not dependent upon the needs of microorganisms.

D183

LAGOONS GET SECONDARY TREATMENT OK,

The American City and County, Vol. 92, No. 12, p 41-42, December, 1977. 1 fig, 1 tab.

The two main problems encountered in operating waste water treatment lagoons are short-circuiting and hydraulic or organic overloading. Insufficient sunlight will kill the oxygen-producing algae, thus limiting the growth of aerobic bacteria that degrade the organic wastes. The lower part of the ponds should be sealed to prevent water from leaking out through the surrounding soil. Covering the earth berms around the lagoons with asphalt is the preferred method of preventing erosion; vegetation is usually unsuitable. The piping system should allow the operator to control flow and depth in each pond. Such a system makes it possible to rest an overloaded pond, switch between parallel and series operation, recirculate part of the effluent, control weeds, and retain all effluent during the winter.

D184

STATE OF THE ART IN WATER TREATMENT DESIGN, INSTRUMENTATION, AND ANALYSIS,

Ryder, R. A.

Kennedy Engineers Incorporated,
San Francisco, California.

Journal of the American Water Works Association, Vol. 69, No. 11, p 612-620, November, 1977. 14 tab, 17 ref.

Sampling and analysis is recommended for the identification of water quality variations which may influence treatment choice. Water treatment methods include chemical addition, flocculation, sedimentation, filtration, taste and odor removal, corrosion and scale control, and disinfection. Waste water recovery has been practiced for many years in California. Waste water recovery ponds usually contain two basins. Pumps convey the waste water back into the treatment plant's rapid-mixing chamber. Alum-coagulant and iron-coagulant sludges are often very compressible, but only thicken naturally to about 10% solids. Precoats or chemical additives are often required to filter or centrifuge the sludge efficiently. Polyelectrolyte coagulants produce much smaller quantities of sludge, reducing sludge handling five to 10 times compared with alum sludge requirements. Sludge-disposal methods include: air drying followed by burial, spraying on land, and mechanical dewatering. Mechanical dewatering is often the only method available for concentrating sludge if the treatment plant site is restricted or too wet for air drying. Despite the availability of improved centrifuges and automated press-leaf filters, mechanical dewatering is still costly. Water treatment plants frequently monitor turbidity with a pilot filter to protect against coagulant chemical inadequacy.

D185

HEAVY METALS IN SEWAGE SLUDGE MAY MAKE IT UNSAFE FERTILIZER,

Farm Chemicals, Vol. 140, No. 11, p 98, November, 1977.

Sewage sludge may contain too much cadmium, zinc, and copper to allow safe, application of the sludge as fertilizer on farm lands. Although crop growth can be enhanced by nutrients in sewage sludge, the levels of heavy metals in the edible parts of corn, potatoes, soybeans, wheat, and sorghum crops should be monitored. During recent tests in which 20 tons of sewage sludge per acre were applied to the soil, a significant increase in cadmium and other heavy metals was observed in corn, potatoes, and wheat planted the following year. Levels of cadmium were increased by 22 times in corn, 27 times in wheat grain, and 4.3 times in potatoes. The average diet presently contains about 80% of the safe level of cadmium. Therefore it is suggested that cadmium levels not be increased in soil through the application of heavy metal-rich sludges.

D186

BREATHING NEW LIFE INTO POLLUTED WATERS,

Chemical Week, Vol. 121, No. 20, p 47-48, November, 1977.

A new plan has emerged for on-site clean-up of polluted rivers and lakes. The process employs ships equipped with liquid oxygen aeration units. Two Oxynautes have been built and tested successfully on the Seine and Deulle Rivers in France. The larger of the two ships, the Poseidone C 1000 can treat 5,800 liters of waste water/sec. The Poseidonie C 500 treats 2,900 liters/sec. The process can be applied to municipal wastes as well as industrial wastes containing hydrocarbons. In the continuous treatment process on board ship, turbine-propelled blades mix liquid oxygen with waste waters pumped into a shipboard mixing chamber. Mixing is done under pressure to create high dissolved oxygen levels in the water. The oxygenated water returned to the waterway provides an environment suitable for the bacterial consumption of organic wastes. Dissolved oxygen levels in the range of 0.3-10.0 mg O_2/liter of waste water are required for the process.

D187
DECOMPOSITION OF SEWAGE SLUDGE COMPOST IN SOIL: I. CARBON AND NITROGEN TRANSFORMATION,

Tester, C. F., Sikora, L. J., Taylor, J. M., and Parr, J. F.

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United States Department of Agriculture,
Agricultural Research Service,
Beltsville, Maryland.

Journal of Environmental Quality, Vol. 6, No. 4, p 459-463, October-December, 1977. 3 fig, 2 tab, 32 ref.

The rate and extent of decomposition of sewage sludge compost in soil was studied in laboratory-scale incubation experiments. Freeze-dried compost made from undigested sewage sludge was added to a loamy sand, a silt loam, a silty clay, and a sand at rates of 0, 2, 4, and 6% of the dry weight. The soil-compost mixtures were incubated at 22 C in a constant CO2 atmosphere under NH3-free conditions. Mineralization and decomposition rates were measured according to CO2 and NH3 evolution and changes in the organic and inorganic fractions of C and N with time. The cumulative CO2 evaluation was linearly related to the sludge compost application rate. About 16% of the compost C evolved in 54 days of incubation. N mineralization was lowest in the silt-loam compost mixture. In the sand-compost mixture, mineral N was immobilized during incubation. Evolution of NH3 from all mixtures was minimal. About 6% of the compost N in the loamy sand-compost mixture had mineralized after 54 days of incubation. Interlattice fixation of NH3 may have occurred in the silt loam and silty clay soils. The study demonstrated that the application of sewage compost to different soils can result in different degrees of mineralization, despite the linear relationship between decomposition and sludge application rate.

D188
ALTERNATIVES TO DISINFECTION,

Budde, P. E., Nehm, P., and Boyle, W. C.

Wisconsin University,
Madison,
Department of Civil and Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2144-2156, October, 1977. 11 fig, 6 tab, 22 ref.

A continuous-flow pilot study was conducted for the City of Madison, Wisconsin, to compare the bactericidal effectiveness of three alternate disinfectants on secondary and more highly polished waste water effluents. The dose required to reach a target level kill of 200 fecal coliforms/100 ml was used to assess the bactericidal efficiencies of chlorine, ozone, and iodine. Cost data were prepared with respect to target level and effluent waste water quality. The waste streams tested included nitrified activated sludge, nitrified rotating film effluents, non-nitrified activated sludge, and non-nitrified dual-media filter effluents. Disinfectant sensitivities based on changes in turbidity were O3>I2>Cl2 for nitrified effluents and O3>Cl2>I2 for non-nitrified effluents. Chlorination was less expensive than ozonation as long as dechlorination was not required. Chlorination was adversely affected by the absence of ammonia when the turbidity exceeded 1 JTU.

D189

PILOT PLANT STUDY OF PHYSICAL-CHEMICAL TREATMENT,

Directo, L. S., Chen, C-L., and Kugelman, I. J.

Los Angeles County Sanitation Districts,
Los Angeles, California.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2081-2098, October, 1977. 12 fig, 11 tab, 11 ref.

Pilot plant studies were used to evaluate the large-scale regeneration of granular activated carbon exhausted on chemically clarified waste water. The performance of a chemical clarification system using alum and polymer was examined. Granular activated carbon was evaluated for the removal of soluble organic matter from chemically treated waste water. Techniques of hydrogen sulfide control and thermal regeneration of activated carbon were also tested. The pilot plant included a chemical clarification system followed by a single-stage, packed bed, downflow granular activated carbon column. Carbon-treated effluents during the 27-month study averaged 13.5 mg/liter COD, 6.7 mg/liter suspended solids, 6.3 JTU turbidity, and 7.8 color units. Losses during carbon regeneration ranged 2.5-6.0%. Continuous sodium nitrate addition to the column was more effective than oxygen addition, chlorination, or air-water backwash for hydrogen sulfide control. Costs for a 10 mgd physical-chemical treatment system, designed to produce an effluent with an average total COD of 25 mg/liter, dissolved COD of 16 mg/liter, and suspended solids of 8 mg/liter, were projected at $0.07/cu m with the use of alum and polymer.

D190

EFFECT OF EXOCELLULAR POLYMER PRODUCTION ON THICKENING AND DEWATERING CHARACTERISTICS OF ACTIVATED SLUDGE,

Gulas, V., Bond, M., and Benefield, L.

Water and Sewage Works, Vol. 124, No. 11, p 83, November, 1977.

The bioflocculation of bacterial cells in activated sludge can affect sludge thickening and dewatering characteristics which ultimately control sludge handling requirements. The agglutination of cellular organic material produces readily settleable aggregates and also aids in overcoming biomass shearing during sludge pumping and processing. This phenomenon allows removal of the organic matter which has been oxidized by the bacterial cells. Investigations were conducted to describe the quantitative production of exocellular polymers in activated sludge during continuous operation. The mode of release of this polymeric material was also examined. Exocellular polymer concentrations were compared with the degree of thickening observed during dissolved air flotation of the sludge. The influence of naturally produced polymers on the dewatering behavior of activated sludge was evaluated.

D191

ULTILIZATION OF WASTEWATER RESIDUES TO RECLAIM DREDGED EMBANKMENTS,

Go, T. L., Vasuki, N. C., and Canzano, P. S.

Water and Sewage Works, Vol. 124, No. 11, p 83-84, November, 1977.

Problems associated with the disposal of municipal waste water sludge containing higher than normal heavy metal concentrations have resulted in a study by the City of Wilmington, Delaware, on the utilization of wastewater residues for the reclamation of dredged embankments. The federally owned land along the banks of the Chesapeake and Delaware Canal was selected as the sludge disposal test site. Advantages afforded by the site included: protection of the water table aquifer by the mound of dredged materials, little potential for harvesting of food crops, and the need for stabilization of the dredge spoils. Studies were conducted to compare dredge spoil reclamation with digested sludge and commercial fertilizer. Digested sludge from the Wilmington sewage treatment plant was applied to the 16-acre test site at a rate of 45 tons per acre. The area was then seeded with a K-31 tall fescue. Soil core samples taken before and after sludge application were analyzed for metals and anions. The pH of the soil water extract was also measured. Experiences with the sludge application were favorable, as the low pH of the dredge spoil was raised from 3 to 4. The growth and regrowth responses of grasses in the sludge-treated area were also improved. Sludge application reduced the leaching of heavy metals from the dredge spoils.

D192

THE GREAT LAKES CLEANUP,

Walker, K. H.

Great Lakes Regional Office,
International Joint Commission,
Windsor, Ontario, Canada.

Water and Sewage Works, Vol. 124, No. 11, p 85, November, 1977.

The 1972 Great Lakes Water Quality Agreement was adopted to ensure effective pollution control via Canadian and American programs. One of the major goals of the project was to reduce phosphorus inputs and control eutrophication in the Great Lakes. Effluent standards for municipal waste water discharge have been set at 1.0 mg/liter for plants discharging in excess of 1 mgd. Although phosphorus loadings have decreased since 1975, to date only 9 of the 44 municipal waste water treatment plants are meeting phosphorus standards. Current activities of the International Joint Commission have been directed toward evaluating the use of sodium nitriloacetate as a replacement for phosphorus in laundry detergents. The commission also plans to provide information on Great Lakes water quality and the persistence of toxic chemicals in the Great Lakes ecosystem.

D193

SYKES HANDLE PUMPEX SUBMERSIBLES,

Water and Waste Treatment, Vol. 20, No. 10, p 7, October, 1977.

Pumpex AB of Sweden is producing a line of submersible drainage and sewage pumps. Six sizes of drainage pumps are available with 15 different versions capable of outputs of 70-840 gpm. Two of the models have torque flow impellers and are specifically designed for pumping solids in waste water. Drainage pumps suited to restricted access areas, such as deep wells and narrow trenches, are produced with overall diameters of 11.25 inches. A wide variety of sewage pumps for treatment plants and main drainage systems are produced by Pumpex. The sewage pumps have interchangeable components, allowing for many variations. The sewage pumps handle a capacity from 2100 gpm, when equipped with single channel impellers, and up to 1210 gpm with torque flow models.

D194

LAND APPLICATION GUIDELINES FOR SLUDGES CONTAMINATED WITH TOXIC ELEMENTS,

Garrigan, G. A.

Northern Virginia Community College,
Woodbridge,
Division of Environmental and Natural Sciences.

Journal Water Pollution Control Federation, Vol. 49, No. 2, p 2380-2389,
December, 1977. 5 tab, 25 ref.

Guidelines proposed for regulating the land application of municipal sludge containing toxic elements are reviewed. The first guideline limits sludge application on the basis of maximum concentrations of toxic elements in the sludge or the maximum ratio of ammonium nitrogen to toxic element concentrations. The major toxic elements discussed are zinc, copper, nickel, boron, and cadmium. The second guideline proposes maximum allowable concentrations of zinc, copper, and nickel in sludge destined for application to soils having no previous history of sludge application. This guideline would be modified to set limits for toxic elements in soil already having received sludge. The toxicity of cadmium to animals and humans is the concern of another guideline. An optimum nitrogen, or nutrient, loading rate to soil is suggested in the last guideline.

D195

IMPROVING SLUDGE INCINERATION AND VACUUM FILTRATION WITH PULVERIZED COAL,

Hathaway, S. W., and Olexsey, R. A.

Ultimate Disposal Section, Wastewater Research Division,
Environmental Protection Agency Municipal Research Laboratory,
Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2419-2430,
December, 1977. 8 fig, 8 tab, 6 ref.

More efficient methods of filtration and combustion of primary sludge which involve the addition of pulverized coal before the dewatering process were tested. Autogenous incineration of the sludge was calculated as occurring at a 25.9% cake solids content with a stack gas temperature of 427 C. Sludge is normally incinerated with the aid of supplementary fuels such as natural gas or fuel oil. The effects of adding coal to the sludge before and after dewatering were examined. Mixing the coal and sludge before filtration yielded a higher solids concentration in the filter cake. Experiments with pulverized coal additions in the range of 0.1-0.4 kg/kg dry sludge solids determined that autogenous combustion could be achieved with the addition of 0.11 kg coal/kg dry sludge solids. For dewatering with a vacuum filter, the addition of the pulverized coal to the sludge increased filter yield or throughput.

D196
ENERGY FROM SLUDGE DIGESTION--A DEVELOPING RESOURCE?,

Thompson, L.

Process Engineering, p 44-45, August, 1977. 2 fig, 2 tab, 6 ref.

Methane gas produced during sludge digestion in municipal waste water treatment is proposed as an alternate energy source. Methane is generated, along with carbon dioxide, ammonia, and water, as a by-product of the breakdown of complex organic compounds. This breakdown enhances dewaterability and reduces the quantity of organic solids and pathogenic organisms. Waste water treatment plants in England serving a population of more than 100,000 accelerate sludge digestion by raising the temperature in the storage tanks to 30-35 C. This temperature increase improves gas production and shortens the time required for the digestion process. The methane produced by this process can be used to generate heat and electricity for treatment plant operations. Other uses have included heating of offices and greenhouses, substitutes for gasoline, refrigerating agents, incendiary bombs, and various research purposes.

D197
CATALYTIC DEODORIZING SYSTEM FOR HUMAN MANURE GAS, (Shokubai sanka ni yoru shinyo gasu no dasshu shisutemu),

Watake, H., and Horikawa, T.

Toshiba Rebyu, Vol. 32, No. 10, p 824-834, 1977. 7 fig, 1 tab, 3 ref.

High concentrations of hydrogen sulfide in sewage gas have generally required pretreatment before contact with a catalytic oxidation system. A system developed by the Toshiba Company of Japan eliminates the need for pretreatment of sewage gas before deodorizing by catalytic oxidation. A corrugated honeycomb catalyst is used in the Toshiba deodorizing system. The new system is operated at higher than usual temperatures and can effectively reduce the high concentrations of hydrogen sulfide in the sewage gas without deleterious effects on the catalyst. The Toshiba deodorizing system has been installed at Amagasaki City in Japan.

D198

IMPACT OF COMMUNITY PLANNING ON QUALITY OF LIFE IN THE NORTH,

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Department of National Health and Welfare,
Edmonton, Alberta, Canada.

Canadian Journal of Civil Engineering, Vol. 4, No. 4, p 436-444, December, 1977. 4 fig.

Environmental planning is necessary in northern Canadian communities to alleviate unsanitary living conditions and to protect the environment. Long range environmental engineering must conform with the severe climatic conditions in northern Canada. The climate and the isolated nature of the area also contribute to high construction costs and failure of conventional waste disposal and water supply methods. Settlement sites, road layout, recreational facilities and parks are considered important in planning. Consolidation of communities could provide the solution to problems such as ice fogs, high costs of long lengths of pipe needed for sewerage and water distribution systems, and road maintenance and building. Examples of well planned communities in Finland, Greenland, and Iceland are cited as evidence that environmental problems can be overcome with advanced planning. Suggestions for insulated sewage and water pipes, waste disposal, and community planning are given.

D199

PRECIPITATED WASTE WATER PHOSPHORUS AS FERTILIZERS (Abwasserphosphate als Duengemittel),

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Gottingen, West Germany.

Deutsche Gewaesserkundliche Mitteilungen, Vol. 21, No. 1, p 6-7, 1977. 9 ref.

The use of phosphorus precipitated from municipal waste water as a fertilizer was investigated. The precipitation of phosphorus using mechanical and biological methods resulted in only 30% removal. A 95% removal of phosphorus was realized through chemical treatment using ferric and aluminic salts or lime. These phosphorus precipitates were tested for their solubility and yielding properties. The tests were performed to gain a better understanding of the effectiveness of phosphorus precipitates from waste water as a fertilizer. Phosphorus is contributed to water through soil erosion, drainage, excrement, both animal and human, and detergents. The amount of phosphorus contributed by municipal waste water is calculated at 3-4 g/person.

D200
TREATMENT: NOT A THING OF THE PAST,

Water and Wastes Engineering, Vol. 14, No. 12, p 21, December, 1977.

Waste water treatment and collection facilities, having a capacity of 30 mgd with provisions for expansion to 100 mgd, were completed in 1976 for Raleigh, North Carolina. The system was designed to serve the waste collection needs of the city through the year 2020. In 1886, Raleigh's sewer system discharged untreated waste water into the Walnut Creek and Crabtree Creek, tributaries to the Neuse River. A suit was filed against the city of Raleigh by a town whose water supply came from the Neuse River. Although the 1930's suit was dismissed, after World War II Raleigh was forced to construct sewage treatment facilities. The plant, completed in 1956, employed primary treatment, filters with secondary clarifiers, anaerobic digestors, sludge thickening and dewatering, and chlorination. Plans for the new waste water treatment facilities began in 1969 when the original system became overloaded. The treatment system, which cost over $26 million, has three sewer interceptors, two sewage lift pump stations, and a waste water treatment plant.

D201
SACRAMENTO REGION MOVES FAST ON WASTEWATER CLEANUP,

Engineering News-Record, Vol. 200, No. 3, p 52, January, 1978.

The Sacramento County Regional Sanitation District's $395-million secondary waste water treatment system is scheduled to become operational late in 1980. The federal funds for the project comprised the largest waste water treatment project grant awarded at the time. In the early 1970's, the 21 separate waste water collection and treatment systems in the Sacramento area were under pressure from the state of California to improve their treatment facilities. By late 1973, agreements were signed to construct a central plant. A $75-million bond issue was approved by a 75.5% vote in June, 1974, for a plant to serve a population of 70,000 in the 1980's. Property tax rates were immediately raised to pay off the separate agencies' $25 million in debts. Sewerage costs were also increased, and will be further increased, when the system is fully operative, to about $7 monthly for residential users.

D202

FULL SCALE EXPERIMENTATION ON THE NEW JOHANNESBURG EXTENDED AERATION PLANTS,

Nicholls, H. A.

City Health Department,
Johannesburg City Council,
South Africa.

Water SA, Vol. 1, No. 3, p 121-132, October, 1975. 20 fig, 3 tab, 6 ref.

Full scale experiments were carried out to verify the long solids retention time concept, the biological flocculation concept, the Bardenpho process to remove nitrate, and the modified Bardenpho process to remove nitrate and phosphate. Most of the study was conducted at the Alexandra Works, north of Johannesburg in South Africa. The waste water treatment facility was an extended aeration plant which treated 27-33 megaliters/day during the course of the study. The theories were found to be correct. The use of a long sludge age produced a sludge with good flocculation properties, and a high settling velocity. The plant's operational procedure could be changed to remove nitrate without additional cost. With nitrate removal, no sludge would rise in settling tanks and the sludge could be thickened. An increase in pH when nitrates were removed from the mixed liquor was advantageous in nitrification. Removal of 45% of the phosphate was possible without additional cost.

D203

ECONOMIC ASPECTS OF WASTEWATER TREATMENT IN SOUTH AFRICA,

Bolitho, V. N.

Johannesburg City Council,
South Africa.

Water SA, Vol. 1, No. 3, p 118-120, October, 1975. 2 tab.

South Africa's rapidly expanding urban population will require an additional 10,000-12,000 megaliter/day of waste water treatment capacity. The construction and operating costs of extended aeration plants of 100 megaliter/day capacity are estimated. New cost structures for sludge disposal methods must be considered. Capital investments and operating costs for waste water treatment over a 25-year period are estimated for various types of treatment. The cost of treating municipal waste water to potable water standards is competitive with that of supplying potable water from surface water supplies. A charge levied on industries, based on the cost for treatment of their waste by the municipality, forces the industry to consider pretreating the wastes before discharging them to the municipal sewer. In the Johannesburg region, a regional sewage system serves a total of 1.75 million people in the municipality and eight other local authorities at about half the cost of independent services in the peripheral areas.

D204

WATER RECLAMATION--QUALITY TARGETS AND ECONOMIC CONSIDERATIONS,

van Vuuren, L. R. J.

National Institute for Water Research,
Pretoria, South Africa.

Water SA, Vol. 1, No. 3, p 133-143, October, 1975. 4 fig, 10 tab, 6 ref.

In Southern Africa, secondary effluents have been reclaimed for industrial and other purposes for some time. Most effluents from conventional sewage treatment plants have marked diurnal and seasonal variations in quality with regard to ammonia nitrogen, organic carbon, and alkalinity. Mineral quality, ammonia nitrogen, dissolved organc constituents, and suspended solids all affect the suitability of water for reuse. During recent years advanced treatment technology for waste water reclamation has progressed considerably. The Windhoek and the Stander waste water reclamation plants in South Africa each treat 4.5 Mliters/day using lime treatment and carbon filtration. It is possible to produce water meeting World Health Organization standards at an approximate cost of 10 South African cents/kiloliter. Alum and polyelectrolyte additions were used at another plant to improve treatment of waste water for reuse in pulp bleaching operations. The reuse of waste water for industrial purposes is possible at competitive prices and would be a rational way to deal with increasing water demands. Strict operational control of reclamation plants is required to produce potable water. Improved sewage treatment processes and separation of toxic industrial wastes can greatly reduce risks.

D205

EFFECTIVE PHOSPHORUS REMOVAL FROM SEWAGE BY BIOLOGICAL MEANS,

McLaren, A. R., and Wood, R. J.

National Institute for Water Research,
Council for Scientific and Industrial Research,
Pretoria, South Africa.

Water SA, Vol. 2, No. 1, p 47-50, January, 1976. 5 fig, 1 tab, 5 ref.

The effects of an anaerobic stage on phosphorus removal by nitrifying-denitrifying activated sludge treatment facilities were investigated. Treatment of settled domestic sewage was studied with a 36 liter/day laboratory unit and a 50,000 liter/day pilot plant in Daspoort, Pretoria, South Africa. Phosphorus in sludge was almost completely eliminated by release in an anaerobic stage. A minimum residence time under anaerobic conditions appears necessary for removal of phosphates. The phosphate removal mechanism is apparently purely biological, since aeration and nitrate addition resulted in rapid uptake of phosphates which were subsequently released under anaerobic conditions.

D206

STUDIES ON DISINFECTION AND CHEMICAL OXIDATION WITH OZONE AND CHLORINE IN WATER RECLAMATION,

Ross, W. R., van Leeuwen, J., and Grabow, W. O. K.

National Institute for Water Research,
Pretoria, South Africa.

Water SA, Vol. 2, No. 1, p 25-32, January, 1976. 6 fig, 2 tab, 34 ref.

The feasibility of using ozone for disinfection and oxidation of organic compounds in reclaiming water from sewage was investigated in laboratory and pilot plant studies. Laboratory studies showed Psuedomonas aeruginosa to be more resistant to chlorine and ozone than Aeromonas hydrophila, Acinetobacter anitratum, and Escherichia coli. A pilot plant with a 48-liter ozone reactor and a 30-liter chlorine reactor was used to study disinfection efficiencies at the 4.5 M-liter/day Stander Water Reclamation Plant at Daspoort, Pretoria, South Africa. Pseudomonas aeruginosa was used as the test organism. The disinfection studies showed ozone and chlorine to be equally efficient for disinfecting chlorine demand-free water, although ozone was more efficient for water that had a chlorine demand. This difference was attributed to the reaction of chlorine with nitrogenous substances to produce chloramines, which are not as efficient at disinfection as chlorine. Further laboratory studies ozonated test solutions of pesticides and detergents for 3-5 min in a reactor column. Ozone efficiently oxidized parathion, fenthion, lindane, dieldrin, Manoxol OT, and LAS, which conventional chlorination does not oxidize. Combinations of chlorine and ozone were recommended for disinfecting certain types of waste water. Ozonation and activated carbon filtration followed by chlorination were suggested to make water reclamation more economical and efficient.

D207

DISPOSAL OF SEWAGE SLUDGE ON LAND,

Water Services, Vol. 81, No. 979, p 539, September, 1977. 1 ref.

The beneficial effects of sewage sludge disposal by land application can outweigh hazards if recommended guidelines are observed. The interim guidelines for sludge application should optimize nutrient use and minimize any hazard to humans, animals, crops, the soil, or the environment. The guidelines published in a report by England's Department of the Environment and National Water Council provisionally recommended application rates for numerous elements, including nitrogen. The guidelines are not mandatory, but are interim targets pending publication of more scientific criteria. Comments on the guidelines are being solicited by the Department of the Environment in London, England. England's Standing Committee on the Disposal of Sewage Sludge was set up by the Department of the Environment and the National Water Council in 1975. The Committee is responsible for reviewing land disposal of sewage sludge and drafting a code of standard for sludge disposal.

D208

FATE AND BEHAVIOR OF SELECTED HEAVY METALS IN INCINERATED SEWAGE SLUDGE,

Dewling, R. T.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2103, 1977.

Physical properties and heavy metal concentrations were measured for sludge and ash from eight waste water treatment plants handling up to 50% industrial waste. The median particle size of fluidized bed incinerator ash averaged 18.8 microns, and the median diameter of multiple hearth ash was 47.5 microns. Copper, chromium, cadmium, lead, nickel and zinc were preferentially concentrated with decreasing ash particle size. This relationship was attributed to the form of the metals in the sludge, non-discriminate precipitation and adsorption of the metals during drying in the incinerator, and collapse during combustion of the metal-containing sludge matrix. Over 97% of the mercury contained in raw sludge was released to the atmosphere at combustion temperatures over 1350 F. Copper, chromium, cadmium, lead, nickel, and zinc emissions were under 1% of the total weight of metal contained in the sludge. The ash metal content ranged 78-95%, depending on the metal, of the total content in raw sludge.

D209

THE EFFICACY OF INCLINED TUBE AND PLATE MODULES IN A HIGH LIME CLARIFICATION PROCESS,

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Council for Scientific and Industrial Research,
Pretoria, Republic of South Africa.

Water Research, Vol. 11, No. 9, p 783-788, 1977. 6 fig, 5 ref.

A study was performed to ascertain whether tube and plate systems would improve the performance of a clarifier in a high lime coagulation/clarification process. The study was performed at the Stander water reclamation plant, which uses the high lime process for chemical coagulation of biofilter humus tank effluent. Sludge is produced at a rate of approximately 2000 kg dry solids per day. The use of inclined tube and plate modules in the upper part of the high lime clarifier improved the quality of the overflow. Hydraulic loading, pH, and temperature, within defined limits, had relatively little effect on the modules' performance. Flocculant dosage and clarifier turbidity strongly influenced the performance of the modules. At clarifier turbidities over three Jackson turbidity units, the modules reduced carry-over of suspended material by more than 50%. Although the modules were essentially self-cleaning, hosing and brushing down were required approximately every 3 mos. Annual acid washes were also recommended to ensure continuous satisfactory operation.

D210

AUTOMATION OF WASTE WATER TREATMENT PLANTS: CONCLUSION--EXPERIENCES AND USE,

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Norwich, United Kingdom.

Effluent and Water Treatment Journal, Vol. 17, No. 9, p 461-465, September, 1977. 9 ref.

The Whitlingham works of the Norwich Sewage Division of the Anglian Water Authority have recently been extended to handle a design daily waste water flow of 55,000 cu m/day. The Whitlingham plant serves Norwich, England, and the surrounding area. Since late 1973, new plant and automatic control sequences gradually came into use. Initial problems involved preliminary treatment, primary sedimentation, the activated sludge plant, sludge pumping, sludge digestion, filter pressing, and motorized valves and penstocks. A problem with foaming in the digesters was alleviated by adjustments in operating temperature, frequency and duration of mixer operation, and frequency of feeding. Automatic control helped remedy problems associated with a dissolved oxygen deficiency and sludge bulking in the activated sludge plant. Twenty-two workers operate the automated facility, as compared with 20 before the plant capacity was doubled and automatic control sequences were installed. The power costs of preliminary and storm water treatment have also been reduced.

D211

WET AIR OXIDATION: EFFECT ON SLUDGE COMPOSITION,

Sommers, L. E., and Curtis, E. H.

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West Lafayette, Indiana,
Department of Agronomy.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2219-2225, November, 1977. 2 fig, 4 tab, 6 ref.

A study was performed to obtain information on the forms of N, P, Cu, Zn, Ni, Cd, and Pb in sludges processed by wet-air oxidation. Wet-air oxidation, a pretreatment process to aid sludge dewatering, maintains the sludge at pressures of 2340-2480 kN/sq m and temperatures of 180-200 C to cause partial oxidation of organic matter and alteration of the sludge's physical characteristics. Samples of sludge and decant liquors, taken before and after wet-air oxidation, were obtained from the Terre Haute and Speedway, Indiana, waste water treatment plants. The Terre Haute plant receives an average daily flow of approximately 34,065 cu m/day, and the Speedway plant receives an average daily flow of approximately 17,000 cu m/day. Generally, total nitrogen reductions averaged over 50% with wet-air oxidation, although metal concentrations did not change or increased slightly. To satisfy a crop's nitrogen requirement using wet-air oxidized sludge, higher sludge application rates will be required. This will, in turn, increase the annual rate of metal application. The number of years the disposal site can be used will be reduced if wet-air oxidized sludges are used. Wet-air oxidation tends to increase the phosphorus content of sludges. Some sludges are unsuitable for wet-air oxidation. If land application will be used for sludge disposal, wet-air oxidation may not be feasible.

D212

SERVO CONTROLLED OPTIMIZATION OF NITRIFICATION-DENITRIFICATION OF WASTE WATER IN SOIL,

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Robert S. Kerr Environmental Research Laboratory,
Ada, Oklahoma.

Journal of Environmental Quality, Vol. 6, No. 4, p 456-458, October-December, 1977. 5 fig, 1 tab, 9 ref.

Studies were conducted to develop a servo control system which adjusts the rate of waste water application to land to ensure nitrification-denitrification. Operation of the control system is based on the potentials of five platinum electrodes used in conjunction with a Calomel reference electrode. A servo controller was used to regulate application of municipal trickling filter final effluent to four gravelly loam soil columns. The controller adjusted the frequency of waste water application with respect to the Pt electrode potential 6 cm under the soil surface. The duration of each application was regulated according to a target potential measured 30 cm beneath the surface, optimizing denitrification. Three soil columns received 7.5 metric tons (carbon) of digested municipal sludge/ha in the upper 30 cm of the profile. Waste water application was continuously allowed by the servo controller for the column that contained no sludge. Essentially all total Kjeldahl nitrogen-nitrogen was converted to nitrate-nitrogen in the upper 3 cm of this column. About 45% of the dissolved nitrogen disappeared in this column. Addition of sludge increased apparent denitrification, so that total nitrogen removal exceeded 90%.

D213

EPOXY COATED GRATING RESISTS CORROSION IN SEWAGE PLANT APPLICATION,

Kelly, E. F.

Water and Sewage Works, Vol. 124, No. 12, p 72, December, 1977.

A potential air contamination problem was presented by the combination of strong chemicals and sewage in waste water treatment and incineration plants located at the confluence of the Detroit and Rouge rivers. A self-ventilating plant was designed. Industrial steel grating was specified for much of the flooring of one of the incinerator complexes. A type of grating that offered the load strength of the regular product, in addition to corrosion resistance, was required. Ponbake epoxy-coated grating from Blaw-Knox Equipment, Inc., in Pittsburgh, Pennsylvania, was selected. Waste flows from residential, commercial, and industrial sources in Wayne, Oakland, and Macomb counties, as well as storm water from Detroit and some Detroit suburbs, are treated. Volumes sometimes exceed 1,000 mgd, but 800 mgd is typical. Ferrous chloride is used to bind phosphates into a settleable form. Coarse screens remove solid materials and grit settling channels further remove inorganic material. The waste water is then treated with polyelectrolyte addition, sedimentation and skimming, aeration, clarification, and chlorination. Treated effluent is discharged to the Detroit River; sludge is dewatered and transferred to 14 multiple hearth furnaces. The ash is transported to a landfill. The industrial grating at $3-5/sq ft was much less costly than conventional steel and concrete flooring.

D214

PUBLIC HEALTH ASPECTS OF LAND UTILIZATION OF WASTEWATER EFFLUENTS AND SLUDGES,

Wolman, A.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2211-2218, November, 1977. 2 tab, 17 ref.

The history and development of land-application of waste water and sludges are presented. In 1922, Baltimore authorities were permitted to use wet waste water sludge for fertilizer so long as certain conditions were met. The sludge had to be digested for at least 10 days, transported in water-tight vehicles, and applied before crops were planted. Soil accumulation of heavy metals contained in sludge had been considered to pose a hazard under certain circumstances. Although land disposal must be accompanied by cautious pesticide use, the latter cannot be considered as a primary constraint. Land disposal experiences over more than 100 years have indicated that application of waste water or its derivatives to land is practicable, provided it is carefully, efficiently, and continuously managed. A site with appropriate soil permeability and porosity must be available. Provisions must be made for storage in wet weather. Waste water should not be used to fertilize crops which are eaten raw. A monitoring program to protect groundwater quality should be instituted. Potential hygienic risks must be detected and controlled. Land application as a means of sewage disposal is limited in the United States by regional variations in geology, hydrology, meteorology, and topography. The process may not always be cost-effective.

D215

"USED" WATER USED AGAIN FOR IRRIGATION,

Crops and Soils Magazine, Vol. 30, No. 3, p 24, December, 1977.

Irrigation of farmland has been suggested as a means of recycling large amounts of sewage treatment effluent, especially in California. California produces 1.7 million acre-feet of reusable waste water annually. Currently, two-thirds of this is discharged directly into the ocean or estuaries. Municipal waste water has already been used to irrigate small areas of farmland owned by California sewage treatment agencies. Water supply and water treatment systems are usually coordinated by different agencies, making cooperative planning difficult. Major waste water sources are also usually located some distance from farming operations which need supplemental water. There are also uncertainties involving benefits and costs, crop yields, and soil and water resources. Some stable organic compounds found in waste water may be dangerous. Ideally, both the farmer and the city should benefit from waste water reclamation for irrigation.

D216

JURY ON LAND DISPOSAL OF WASTEWATER STILL OUT, MR. COSTLE,

Baxter, S.

The American City and County, Vol. 92, No. 12, p 28, December, 1977.

Health aspects of waste water and residual disposal on land were discussed at the Water Pollution Control Federation's (WPCF) 1977 annual conference. The Environmental Protection Agency (EPA) will urge publicly-owned treatment plants to use land treatment to reclaim and recycle municipal waste water. The engineer designing a treatment plant must present evidence against the feasibility of land application before standard mechanical and biological treatment processes can be adopted. The health problems associated with land disposal are not entirely understood. It is not known whether experience with land disposal in Muskegon, Michigan, will be sufficient to ensure 1983 and 1985 water pollution abatement goals. Land disposal should only be considered when the facility is properly operated and efforts are made to use sound engineering, geological, farming, areal, meteorological, and economic expertise in design, construction, and control procedures. Many of the narrow viewpoints stem from arbitrary legal and regulatory provisions.

D217

FULL-SCALE USE OF PHYSICAL/CHEMICAL TREATMENT OF DOMESTIC WASTEWATER AT ROCKY RIVER, OHIO,

Moss, W. H., Schade, R. E., Sebesta, S. J., Scheutzow, K. A., and Beck, P. V.

Willard F. Schade and Associates, Incorporated,
Cleveland, Ohio.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2249-2254, November, 1977. 3 fig, 5 tab, 3 ref.

The municipal waste water treatment plant in Rocky River, Ohio, processes an average daily waste water flow of 37,850 cu m, using chemical coagulation and carbon adsorption. Operating data for an initial six-month period were used to evaluate performance of the chemical treatment and carbon treatment systems. Samples of influent, primary clarified effluent, and final plant effluent were analyzed for biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, and phosphorus. Samples of primary raw sludge, thickened sludge, and thickener overflow were analyzed for percent solids. The effluent complied with NPDES permit standards for secondary treatment and phosphorus removal. Digested alum sludge production averaged 9.8 kg/sq m/hr; raw alum sludge yield averaged 12.2 kg/sq m/hr. Problems with increased chlorine demand and odor were attributed to anaerobic biological growth within the carbon columns. Sodium nitrate addition and daily backwashing with air scour were used to control hydrogen sulfide production. Operating problems included separation of the rubber lining from the walls of the columns, physical deterioration of the air scour diffusers, and loss of over 20% of the total carbon volume during filtration. The operating cost was approximately $0.079/cu m.

D218

SLUDGE IMPROVES SANDY SOIL, INCREASES YIELDS WITHOUT POLLUTING,

Crops and Soils Magazine, Vol. 30, No. 3, p 23-24, December, 1977.

The use of sewage sludge as a fertilizer can improve crop yields and increase the level of organic matter in sandy soil. Application at crop fertilization rates should not result in nitrogen pollution of groundwater. Anaerobically digested sludge decomposes and releases nitrogen in the soil at a slower rate than other varieties of sludge. Sludge from three waste water treatment plants was applied to sandy soil over a 4-year period at rates of 13, 26, and 52 tons/acre/yr. The highest application rate, representing a normal 15-20 year addition rate, was 210 tons/acre of total dry solids. Corn yields increased by an average of 60 bushels/acre at the high application rates. A control plot which received commercial fertilizer produced 120 bushels/acre. Nitrate levels in soil water below the corn root zone in plots treated with 13 tons of sludge/acre/yr were comparable to those in control plots fertilized with 250 lbs nitrogen/acre. Anaerobic sludge addition raised the organic matter level of the soil surface from 2.1 to 7.5%. Sewage sludge application should be limited to 5-10 tons/acre/yr to maintain high crop yields and low nitrate levels in soil percolates.

D219

A FIELD STUDY OF THE AGRICULTURAL USE OF SEWAGE SLUDGE: I. EFFECT ON CROP YIELD AND UPTAKE OF N AND P,

Kelling, K. A., Peterson, A. E., Walsh, L. M., Ryan, J. A., and Keeney, D. R.

Ball State University,
Muncie, Indiana,
Department of Natural Resources.

Journal of Environmental Quality, Vol. 6, No. 4, p 339-345, October-December, 1977. 6 tab, 29 ref.

The effects of sludge application at rates based on typical fertilizer N applications to high sludge disposal loading rates were examined with respect to crop yields, the residual fertility of the sludge, and the amounts of sludge-applied N and P recovered by the crops. Anaerobically digested liquid sludge was applied to field plots at rates of 0, 3.75, 7.5, 15, 30, and 60 metric tons of dry solids/ha on a sandy loam and a salt loam. Rye or sorghum-sudan was planted in the plots, followed by one to 3 seasons of corn. The first crop after sludge application showed significantly increased yields for application rates up to 7.5 metric ton/ha on silt loam soil and up to 15 metric tons/ha on sandy loam soil. Application of 30 and 60 metric tons/ha occasionally depressed yields of the first crop, possibly due to the presence of large quantities of soluble salts. There were residual benefits from the sludge for 3 years or more at the higher application rates. Generally, an increase in sludge application rate yielded higher concentrations of N and P in plant tissue. Total nutrient recovery averaged about 50% for available N and 7% for P at a low application rate, and about 14% for N and 3% for P at the highest rate of sludge addition.

D220

REVIVING THE SEPTIC TANK,

Bell, H. F.

Bell Construction Company,
Matteson, Illinois.

Civil Engineering-ASCE, Vol. 47, No. 12, p 83-84, December, 1977.

Approximately 25% of the United States population depends on individual sewage disposal systems. The septic tank for a single family house in Illinois is required to have a capacity of 500 gallons for each bedroom in the house. Percolation tests during a summer dry spell are used to determine the necessary trench area. Local requirements, which may call for distribution and drop boxes at strategic locations, influence field design. Septic tank failures in spring are typically caused by saturated soil and exceptionally high load; summer and fall failures usually involve line stoppage. A series of recommendations for improving septic sewage disposal are presented. Only organic wastes should be disposed of in a septic tank. The sludge level should be checked periodically; sludge and scum should be removed when the stored volume approaches total capacity.

D221
EFFECTS OF PH AND MIXING ON POLYMER CONDITIONING OF CHEMICAL SLUDGE,

O'Brien, J. J., and Novak, J. T.

E. I. du Pont de Nemours and Company, Incorporated,
Wilmington, Delaware.

Journal of the American Water Works Association, Vol. 69, No. 11, p 600-605, November, 1977. 13 fig, 2 tab, 13 ref.

Laboratory studies were conducted to evaluate polymer performance with respect to various sludge characteristics, including chemical composition, pH, specific resistance, and cake solids. Polymers were mixed with sludge samples in 300 ml beakers, and the amount of polymer needed to achieve a maximum decrease in specific resistance was determined. Organic polymers can be used to improve dewatering rates of inorganic sludges. The trial-and-error method usually used to select polymers can be greatly simplified when the polymer characteristics are provided. Cationic polymers are most efficient at pH of 7 or less. Nonionic polymers and the lower percent hydrolysis anionic polymers function effectively at pH 6.5-8.5. The effectiveness generally decreased as the pH increased. The 50% hydrolysis anionic polymer was most effective above pH 8.5. Too much or too little mixing can greatly reduce polymer effectiveness. The required degree of mixing depends on the solids concentration in the sludge.

D222
PROCESS MODIFICATIONS OF AEROBIC DIGESTION FOR PRODUCT STABILITY AND NITROGEN CONTROL,

Hartman, R. B.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2326-2327, 1977.

Aerobic digestion was evaluated for reducing odor and nitrate contamination problems associated with land application of sludges from waste water treatment. Laboratory-scale studies indicated that biological oxidation of nitrogenous material in the sludge provided greatest flexibility in sludge nitrogen control. The maximum digestion rate occurred near 30 C. Product stability increased with detention time. The degree of stability depended strongly on a small biodegradable fraction that was oxidized shortly before the end of the digestion process. Additional alkalinity, which could be introduced by including a reactor for biological dentrification in the aerobic digestion sequence, was needed to maintain conditions favorable for completion of the nitrification reactions. Aerobic digestion of waste water sludges was considered viable, yielding a product which was highly stable and suitable for land application.

D223

SLUDGE TREATMENT PROCESS OFFERS FLEXIBILITY, LOW COST,

Evans, R. R.

Dorr-Oliver, Incorporated,
Stamford, Connecticut.

Chemical Engineering, Vol. 84, No. 26, p 86-88, December, 1977. 2 fig, 2 tab.

Split-stream thickening, in which primary and waste activated sludges are separated and concentrated independently before further processing, can result in a savings of about 15% on the capital cost of conventional sludge thickening. Primary sludge is formed when influent is detained in settling tanks; microorganisms, using the dissolved organics as an energy supply, clump together to form activated sludge in a secondary treatment step. It is difficult to accurately predict the amounts of primary and biological sludges that a given facility will produce. When primary and activated sludges are combined at various ratios, operating results will deviate significantly from the design calculations. Dewatering of primary sludge in a conventional gravity thickener and activated sludge with a high capacity centrifuge alleviates these problems. The capital and operating costs for the split-stream process are site-specific, so it is difficult to give meaningful economic data.

D224

KANSAS TREATMENT PLANT USES SUBSURFACE INJECTION OF SLUDGE,

Strain, R. E.

Water and Sewage Works, Vol. 124, No. 11, p 42-44, November, 1977. 2 fig, 1 tab, 1 ref.

Design features of the Manhattan, Kansas, municipal waste water treatment plant include subsurface injection of sludge on farmland, preloading of the poorly consolidated soils, no primary sedimentation, and duplication of power supply and treatment components. The fill material excavated during construction of underground structures at the sludge injection site was used in levees for the storm water lagoon. The activated sludge plant and an interceptor sewer were constructed near a flood control levee on the Kansas River. Wet weather flows in excess of the design maximum dry weather flow are pumped to a storm water settling basin. After excess flows subside, the storm water is returned to the plant for treatment. The treatment system includes an aerated grit removal basin, two comminutors, two aeration basins, two final sedimentation basins, and two chlorine contact basins. Waste sludge is piped to the center of each 16-acre sludge disposal tract at the 120-acre site. A hose carries the sludge to the tractor-pulled subsurface injector. Construction costs of the treatment plant and sludge handling and injection equipment were approximately $7,220,000.

D225

DISINFECTION OF DRINKING WATER, SWIMMING-POOL WATER AND TREATED SEWAGE EFFLUENTS,

Clarke, N. A., and Hill, W. F., Jr.

Biological Contaminants Branch,
Health Effects Research Laboratory,
United States Environmental Protection Agency,
Cincinnati, Ohio.

p 705-722, 2 fig, 100 ref. In: Disinfection, Sterilization, and Preservation, Block, S. S. (ed.), Lea and Febiger, Philadelphia, Pennsylvania, 1977. 1049 p.

In disinfecting water and treated effluents, infectious microorganisms must be destroyed to prevent transmission of pathogens. Because it is difficult to measure some residual concentrations of disinfectants, coliform levels are often used. Whether this accurately measures biological safety has been questioned in view of the resistance of viruses to disinfection. Dosage, contact time, temperature, other organic and inorganic material in the water, and pH can affect disinfection efficiency. Chlorine, chlorine dioxide, bromine, iodine, ozone, silver, ultraviolet radiation, ionizing radiations, and heat have been used to disinfect drinking water. Chlorine and its compounds, iodine, bromine, and silver are used as swimming pool disinfectants. Copper sulfate is used to control algae in pool water. Chlorine and its derivatives are the most widely used disinfectants in sewage treatment. Flash mixing at pH 5.0 can provide disinfection equivalent to four times the normal chlorine dosage. The final product water from advanced waste treatment must be disinfected to prevent transmission of microbial pathogens. The activated sludge process, properly carried out, will eliminate most sugars and amino acids, which can interfere with disinfection. After filtration and adsorption in a carbon column, disinfection with chlorine is easily accomplished. Water must be chlorinated before reverse osmosis to prevent membrane plugging by microbiological growth; the chlorine also disinfects the effluent.

D226

WASTEWATER PLANT HAS AN EYE ON THE FUTURE,

Cannon, W. P.

Water and Wastes Engineering, Vol. 14, No. 12, p 20-26, December, 1977. 1 fig.

The operation of the recently completed waste water treatment facility in Raleigh, North Carolina, is examined. The 30 mgd operation was designed to provide waste water treatment for Raleigh's increasing population through the year 2020 with provisions for expansion to a capacity of 100 mgd. During primary treatment the raw waste water is pumped through coarse bar screens where solids are removed for transport to a sanitary landfill. The first part of secondary treatment includes aeration, followed by secondary settling in earthen basins equipped with drains for transfer of influent to other treatment units. Settled waste water then flows to the return sludge screw pump station and on to secondary clarifiers. A Parshall flume at the return sludge metering station monitors the return flow. Sludge treatment is accomplished by aerobic digesters, sludge thickeners, dewatering, and sludge oxidation. Secondary effluent is processed through automatically backwashed tertiary filters at a rate of 3-7.5 gal/sq ft/min. The backwash rate is 5-22.5 gal/sq ft/min. Effluent is polished by filtration through layers of anthracite coal, sand, and gravel. Chlorination is accomplished by: three chlorinators, each with a capacity of 8000 lbs chlorine gas/24 hrs; three electrical chlorine evaporators; and a chlorine residual analyzer. The plant consists of an administration and laboratory building, a filter building, and a sludge dewatering building.

D227

PERFORMANCE OF THE ACTIVATED SLUDGE PLANT,

Joshi, D. S.

Municipal Corporation of Bombay,
Dadar Sewage Purification Plant,
Bombay, India.

Indian Journal of Environmental Health, Vol. 19, No. 3, p 238-243, 1977. 1 fig, 3 tab, 3 ref, 2 append.

Dadar Sewage Treatment Works in Bombay, India, has a total capacity of 20 mgd using the activated sludge process and trickling filters. Sewage receives primary treatment only. Suspended solids, BOD, and oxygen absorption in treated effluent were measured over a two-year period after a renovation of the sewage treatment plant. The aeration system, site of the renovation, was changed by the replacement of 36 aeration cones by 24 cones installed in four rows. Each aeration cone runs on a six horsepower motor and the 24 cones have the same flow capacity as the original 36 cones. Return sludge pump capacities were increased to 60-65% from 30-35%. Suspended solids levels after primary treatment were reduced by 64.6%, BOD was reduced by 32.4%, and four-hour potassium permanganate absorption by 41.4%.

D228

THIS PLANT MARRIES TWO WASTES,

Clingenpeel, W. H.

Wiley and Wilson, Incorporated,
Lynchburg, Virginia.

Water and Wastes Engineering, Vol. 14, No. 12, p 36-39, December, 1977. 2 fig.

A Virginia waste treatment plant has been redesigned to treat both municipal and industrial wastes. Mead Corporation's Paperboard Mill in Virginia underwent processing modifications that included elimination of pulping, recycling of paper, and recycling of process water. Lynchburg, Virginia's waste treatment facility was upgraded from an 11-mgd primary capacity to a 22-mgd secondary treatment capacity plant. The Mead waste water flow was estimated at 3.0 mgd with a BOD of 14,000 lbs/day. Because treatment of the combined primary sludges was found to be ineffective, primary settling and disposal of the domestic and industrial sludges were conducted separately. Two variable speed pumps and two constant speed pumps, each with a 15 mgd capacity, convey the raw sewage through a Parshall flume to the primary clarifiers. The two aeration basins have a total volume of 7,000,000 gallons. Two sludge removal clarifiers were installed to supplement the two existing clarifiers. A second chlorine tank, a wet air oxidation system, and two sludge dewatering centrifuges were also added to the treatment plant. An ammoniator was added to compensate for the nitrogen deficiency of the industrial flow. The chlorinators and evaporators, with a 16,000 lbs/day capacity, supply high-pressure process water to the plant via a non-potable water pumping station.

D229

RECENT ADVANCES IN SEWAGE EFFLUENT DENITRIFICATION: PART II,

Cooper, P. F., Collinson, B., and Green, M. K.

Water Research Center,
Stevenage Laboratory,
Stevenage, England.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 4, p 389-401, 1977. 8 fig, 7 tab, 3 ref.

Studies were conducted at a 9.1 million cu m/day sewage treatment plant in England to evaluate process modifications to remove all the nitrate present in recycled activated sludge. Anaerobic conditions were created by modification of two of the aeration units in the first part of a four-pass system. Two anaerobic areas were created in the third passes of the two other aeration units. Equal parts of recycled sludge and settled sludge were passed through the anaerobic zone. A 50% nitrate reduction was realized with the modifications in the first two units. Laboratory experiments were conducted to test units with two anaerobic areas under varying conditions of incremental sludge feed recycled sludge proportion. Tests indicated that nitrate removal increased to 69% when 40% of the settled sludge was retained in the second anaerobic zone for 30 minutes. Further studies showed that increasing retention time to 40 minutes resulted in a maximum 76% denitrification of the effluent.

D230

AEROBIC SLUDGE DIGESTION AT COLD TEMPERATURES,

Mavinic, D. S., and Koers, D. A.

British Columbia University,
Vancouver, Canada,
Department of Civil Engineering.

Canadian Journal of Civil Engineering, Vol. 4, No. 4, p 445-454, December, 1977. 8 fig, 1 tab, 17 ref.

The effects of low temperature on the aerobic digestion of activated sludge were examined. Three digester operations, continuous feed, daily fill, and batch aeration, were compared using six sludge ages. Lower temperatures and decreased sludge age were observed to decrease the volatile suspended solids removal rates. A similar reduction in volatile suspended solids removal occurred in the continuous and semi-continuous feed digesters operated at 20 C and 10 C. At 5 C, the volatile suspended solids reduction was greater under semi-continuous operation than in the continuous flow mode for all sludge ages tested. Batch aeration exhibited a high degree of volatile suspended solids removal at 20 C when compared to continuous flow operation at the same temperature, although the reverse proved true at 10 C. Batch aeration and semi-continuous flow operations at 5 C showed similar reduction rates. Volatile suspended solids removal was significantly decreased in laboratory experiments and studies at two treatment plants when the value of the product of sludge age and temperature exceeded 250. Oxygen uptake rates and BOD levels were also significantly affected by sludge age and temperature.

D231

NITROGEN REMOVAL BY ION EXCHANGE: BIOLOGICAL REGENERATION OF CLINOPTILOLITE,

Semmens, M. J., Wang, J. T., and Booth, A. C.

Illinois University,
Urbana,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2431-2444, December, 1977. 14 fig, 1 tab, 12 ref.

The regeneration of clinoptilolite, a zeolite used for removal of ammonium from waste water, by the use of nitrifying bacteria was examined. Clinoptilolite containing high concentrations of ammonium was treated with a slurry of nitrifying bacteria containing 0.3 M sodium nitrate. Biological regeneration of the zeolite during 20 tests occurred over a time range of 1.3-4.6 hrs. The rate of regeneration was found to be based on the rate of nitrification. Optimum nitrification rates were achieved by the addition of pure oxygen to maintain the dissolved oxygen level above 6 mg/liter. Additions of phenol and humic acid to the regeneration process did not have deleterious effects on the nitrifying bacteria or the regeneration process. Chemical regeneration of clinoptilolite at a neutral pH with 0.3 M sodium chloride was more effective than the biological regeneration. This difference was attributed to the production of magnesium and calcium ions in the brine during the biological regeneration process.

D232

CHLORINE AND ACID CONDITIONING OF SLUDGE,

Sukenik, W. H., King, P. H., and Olver, J. W.

California State Water Resources Control Board,
Sacramento, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 1013-1020, December, 1977. 10 fig, 1 tab, 8 ref.

The effects of chlorine and acidity on the filterability and release of organic matter and metals from primary sludge after chlorination were analyzed. Samples of raw primary, anaerobically-digested, and aerobically-digested sludge were treated with 500, 700, and 1,000 mg/liter sodium hypochlorite. The pH was varied from 3 to 7 with applications of sulfuric acid or sodium hydroxide. Observations were made on the specific resistance to filtration, COD levels, and the release of chromium, copper, and zinc after chlorine and acid treatment. Filterability of raw primary sludge improved slightly with the addition of 500 mg/liter chlorine at pH 3 and 700 mg/liter chlorine at pH 4. A significant decrease in filterability was observed at pH 5-7 with low chlorine additions, while the lowest sludge filterability occurred with the 100 mg/liter chlorine treatment. A decrease in pH slightly improved the filterability of anaerobically digested sludge, although overall filterability was unaffected by chlorine or acid treatment. Aerobically treated sludge demonstrated substantial increases in filterability after acid treatment alone. Filtrate COD after chlorine oxdiation increased in raw sludge at pH 4, increased in anaerobic sludge as the pH was lowered, and increased in aerobic sludge with higher chlorine doses. The release of zinc, copper, and chromium increased for raw and anaerobic sludge after chloride treatment at low pH.

D233

DISSOLVED METALS IN AQUEOUS EFFLUENTS FROM MUNICIPAL INCINERATORS,

Law, S. L.

College Park Metallurgy Research Center,
Bureau of Mines,
College Park, Maryland.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2453-2466, December, 1977. 5 fig, 9 tab, 20 ref.

The environmental impact of dissolved metal concentrations in the water systems of three municipal incineration operations was examined. Flyash scrubber water and quench water, utilized in separate processes by Alexandria, Virginia's municipal incinerator, were used as the basis for the study. The combined flyash and quench waters from incinerators in Washington, District of Columbia, and from Montgomery County, Maryland, were also analyzed for dissolved metal contents. Concentrations of 26 elements were measured in water samples taken from the plants during operation and just before discharge of waste water into municipal waste treatment facilities. Levels of dissolved metals in waste water from the three operations were found to be low enough so that biological treatment of wastes in the municipal plants would not be significantly hindered. Zinc concentrations in the Alexandria incineration wastes were considered to be detrimental to biological treatment if discharge were made directly into the waste treatment facility. Comparison of metal concentrations with Environmental Protection Agency drinking water standards revealed consistent excessive concentrations of cadmium, manganese, lead, selenium, and zinc in Alexandria's recycled flyash waters. Further treatment of the water from the three incineration operations would be required before discharge into surface water or public water supplies.

D234
EFFECTIVE PHOSPHORUS REMOVAL BY ADDING ALUM TO SEPTIC TANK,

Brandes, M.

Ministry of the Environment,
Toronto, Canada.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2285-2296, November, 1977. 6 fig, 4 tab, 29 ref.

Significant removal of phosphorus and other contaminants from septic tank effluent was achieved by the addition of aluminum sulfate to septic wastes. Additions of 430 mg/liter of alum were made for each toilet flush in a three-person residence in Ontario, Canada. Samples of septic tank effluent and sludge were taken before and after alum application. The amount of soluble phosphorus contained in the effluent was reduced by 99.2%. The addition of 246.8 mg/liter of alum to the waste resulted in 84.9% phosphorus retention in the sludge with 15.1% released in the effluent. With the same alum application, total coliform levels in the effluent were reduced by 35% and fecal coliforms were reduced by 80%. Further total coliform and fecal coliform removal was achieved with the addition of 430 mg/liter of alum. Ninety per cent of the aluminum content was retained in the sludge while a 19% increase in iron in the sludge was realized with the alum treatment. Sludge retention of sodium, potassium, chlorides, and sulfates increased, while sulfate concentrations in septic effluent also increased with alum addition. The average 53.3% BOD removal with 246.8 mg/liter of alum did not significantly improve with greater alum doses. The alum treatment resulted in a higher sludge precipitation rate.

D235
SEWAGE PLANT SHOWS OFF FANCY FORMWORK,

Engineering News-Record, Vol. 200, No. 3, p 52-53, January, 1978.

A new 300-mgd activated sludge treatment plant is currently being constructed for the Sacramento County, California area to replace the present 25-mgd plant. The completed treatment system, costing an estimated $395 million, will consist of seven pumping stations, 75 miles of interceptor sewers, and the advanced secondary treatment plant. Five existing digesters will be modified for incorporation into the facility; aeration and settlement facilities will be converted to chemical handling facilities. Storm water overflow will be controlled by the present treatment plant which will be converted to a 60-mgd capacity and backed up by a 21,000,000-gal holding lagoon for excess flow. Aeration will be accomplished by a submerged, revolving, conical agitator using high purity oxygen. This type of activated sludge process is considered more effective in controlling BOD of food processing wastes and other organic industrial discharges. Aeration tanks up to 32 feet deep can be used in this system; all facilities will be enclosed to prevent odor emissions.

The treatment facility is expected to reduce BOD by 92% and suspended solids by 88%.

D236

FROM WASTEWATER TO RESOURCE IN ST. PETERSBURG, FLORIDA,

Dove, L. A.

Resource Recovery and Conservation, Vol. 2, No. 4, p 329-336, November, 1977. 9 fig, 3 tab, 8 ref.

A zero-discharge waste water treatment system currently under construction in St. Petersburg, Florida, is described. The system was designed to furnish irrigation and drinking water to an area surrounded by polluted salt-water bays and with a limited fresh water supply. Designs for the system, the first regional recycling operation of its kind in the country, involve the expansion of the four existing secondary treatment plants in St. Petersburg to an increased combined capacity of 340,000 cu m/day. One plant that has undergone modification and expansion has been able to remove 90% of the BOD and suspended solids from the effluent. A tertiary treatment plant provides multimedia filtration, alum feed at 6.0-7.5 mg/liter as a filter aid, flash chlorination, and chlorine injection in a 38,000-cu m retention pond. The effluent produced is of potable quality at 1-2 JTU with 1.0-1.5 mg/liter of residual chlorine after 30 minutes, and 0.2/100 ml or less coliform count. Treated water is transported via a master pumping station to a 22.5-km distribution system for irrigation. During rainy seasons and other periods when irrigation is unnecessary, the treated water is pumped to a deep injection well system with a capacity of 76,000 cu m/day. Nutrients useful in irrigation are retained in the treated effluent. The treatment process will provide 40% of the potable water demand for area irrigation.

D237

PLANNING FOR CLEANING UP AN ESTUARY--PART II: PHYSICAL PLANNING FOR THE MERSEY,

Gouge, R. L., Symes, G. L., and Buckley, A. D.

Journal of the Institution of Water Engineers and Scientists, Vol. 31, No. 5, p 329-350, September, 1977. 8 fig, 2 tab, 11 ref.

Proposals for alleviating the discharge of pollutants into rivers which flow into the Mersey estuary in England are presented. Pollution in the lower reaches of the Mersey estuary consists of the deposition of sewage solids, oils, and fats on the beaches and foreshore. This area also receives approximately 330 megaliters/day of untreated sewage during dry weather flow. Selection of a sewage treatment site to process the sewage from the municipality of Liverpool and the expansion of the existing treatment facilities is recommended. The construction of a treatment plant at Wirral, on the other side of the estuary, is suggested. More economically feasible are the proposals for expanding the drainage area of the sea outfall or constructing another 5-m outfall. Screening of the effluent discharged by the outfalls and digestion plants for the treatment of raw sludge are also recommended. Contributing streams and industrial plants are the major sources of pollution in the upper areas of the estuary. Effluent discharged into the upper estuary has received primary or full treatment but still has a low dissolved oxygen content. Provision for primary sewage treatment is recommended for Widness. The addition of secondary treatment for areas with only primary treatment facilities is suggested by either construction of facilities or transfer of sewage to a secondary plant. The addition of oxygen to upper estuary waters and the installation of a nitrifying plant are also considered.

D238

A STUDY ON WATER POLLUTION CONTROL IN WATER SUPPLY SYSTEMS.--BACKFLOW PREVENTER IN WATER SUPPLY SYSTEMS (Kyusui setsubi ni okeru josui osen boshi ni kansuru kenkyu),

Egawa, T.

Fukui kogyo daigaku kenkyu kiyo, No. 7, p 59-71, 1977. 11 fig, 4 tab, 8 ref.

Prevention of backflow into water supply systems from sanitation facilities is discussed. Backflow of water from sanitation facilities presents a serious threat to water supply systems. Pollution of water supplies can be restricted or eliminated by the use of air gaps or backflow preventers. Air gaps tend to be impractical in areas of limited space, such as closet flush pipes. In such areas of restricted space, the installation of backflow preventers is recommended. The backflow preventer allows air to circulate through the interior openings in the water supply system from the exterior openings of the fixtures. Experiments on the function of backflow preventers produced in Japan are discussed.

D239

INFLUENCE OF TEMPERATURE ON THE PERFORMANCE OF SEPTIC TANK SYSTEMS,

Viraraghavan, T.

ADI Limited, Consulting Engineers,
Fredericton, New Brunswick, Canada.

Water, Air, and Soil Pollution, Vol. 7, No. 1, p 103-110, January, 1977. 2 fig, 1 tab, 13 ref.

The impact of air, liquid, and soil temperatures on the efficiency of septic tank and subsurface tile field operations was studied. Temperature readings were recorded at a northern Canadian site over the period of more than a year in a tile field and three soil depths, in the septic tank and the surrounding soil, and in the air. Mean monthly air temperatures ranged -11.7-23.7 C; the temperature of the sewage in the septic tank never dropped below 15.8 C and never exceeded 21.5 C. Temperatures inside the tile field ranged 3.3-18.7 C; the nearby soil temperatures usually exceeded those of the air. Physical adsorption, especially of phosphates, increased as the temperature decreased. Reduction of BOD at a depth of 1.37 m ranged from a high of approximately 90% at less than 5C to a low of 50% between 10-15 C. The sewage effluent temperature was maintained above freezing by hot water discharged into the system. System efficiences during the summer months were higher, ranging 75-85%.

D240

NO METAL UPTAKE BY CORN OR GRASS,

Agricultural Research, Vol. 26, No. 7, p 10-11, January, 1978.

A study of sewage sludge application to corn and reed canarygrass crops was conducted over a 2-3 year period. A two-year application at a rate of 4 tons/acre/yr of digested sewage sludge was used to fertilize a reed canarygrass crop planted on a 40-acre terraced watershed in Minnesota. A higher annual production yield was obtained with sewage, 4.4 tons/acre canarygrass, than with conventional fertilizer, 3.5 tons/acre. Similar results were found with applications of 4.5 tons/acre/yr to corn and grass crops over a three-year period. Annual yields per acre averaged 108 bushels of corn and 6.5 tons of fodder with sludge as the fertilizer, compared to 102 bushels of corn and 6.1 tons of fodder with conventional fertilizer. The sewage sludge applied to the crops contained chromium, zinc, copper, lead, nickel, and cadmium. The heavy metal content in the sludge-treated corn grain and leaf tissue and in the reed canarygrass was not different from the content in the other crops. Surface and soil waters in the research watershed did not display higher concentrations of these heavy metals nor was there significant movement of pollutants through the groundwater. During snowmelt, spring runoff, and high rainfall, some movement of plant nutrients was detected in surface waters on the sludge-fertilized areas.

D241

THE REMOVAL OF SALT AND ORGANIC MATERIAL FROM SEWAGE EFFLUENT BY ANION EXCHANGE RESINS,

Giddey, T. B. S., De Kock, J. W., and Carr, A. D.

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South Africa,
Department of Chemical Engineering.

Water SA, Vol. 1, No. 1, p 24-27, April, 1975. 2 fig, 3 tab, 3 ref.

Two basic anion exchange resins were evaluated for effective removal of organic materials and anions from maturation pond effluent containing a high salt concentration. Tests were performed with anion columns containing either the microporous, gel-type Amberlite IRA-68 resin or the macroreticular-type Amberlite XE-275 exchange resin, both of which are weak bases with nearly identical structures. COD and anion removal was observed in the anion exchange columns over 30 loadings of the resins. Both exchange resins effectively removed COD, averaging a reduction from 40 mg/liter COD to between 10-20 mg/liter COD. The gel-type resin exhibited a greater capacity for chloride removal; the macroreticular resin demonstrated better removal of organic material. The macroreticular resin's initial volumetric capacity was lower and had a higher operating capacity loss than the gel-type resin. Removal of anions and nitrate ions was similar for both resins. Complete ammonium ion removal was accomplished when anion and cation columns were linked.

D242
DIGGING DEEP TO TREAT DOMESTIC SEWAGE,

Ousby, J. C., Walker, J., and Jones, R. T.

Process Engineering, p 81-84, September, 1977. 3 fig, 6 tab, 6 ref.

The ICI deep shaft, activated sludge treatment process increases oxygen transfer intensity and effectively reduces BOD. The single cell protein fermentation process was modified to allow longer bubbling times at a greater height or depth, resulting in the higher oxygen transfer intensity and a lower power use. The average BOD, COD, and suspended solids removal with a 100-m shaft depth was monitored at a pilot plant over a period of 194 days. BOD was reduced from 182 mg/liter to 7 mg/liter; COD decreased from 317 mg/liter to 83 mg/liter; and suspended solids dropped from 222 mg/liter to 18 mg/liter. The total removal of BOD was 92%. A three-month study of sludge production from conversion of BOD demonstrated that one kg of BOD was converted to 0.5 kg of sludge, suggesting an effective reduction in sludge production. Dewatering characteristics of the sludge were also found to improve with the deep shaft process. A pressed cake containing 38% solids was produced after 4 hours of filtration at 100 pounds/square inch; a cake containing 30% solids was achieved at the same pressure after 2 hours pressing time.

D243
MOBILE DIESELS STAND-BY AT SEWAGE PUMPING STATIONS,

Process Engineering, p 13, September, 1977.

The use of stationary automatic and mobile generators, manufactured by Auto Diesels Braby of England, is suggested for the prevention of waste water flooding in pumping stations or treatment plants during electrical power failures. Automatic generators are recommended for unmanned or remote pumping stations where there is an immediate danger of flooding in the event of a power loss. The standby power of these automatic diesels can be supplied within 20 seconds of an electrical failure. The diesels can also be programmed for manual start in manned operations. The generator, which is hooked into the main controls, can supply the initial high voltage necessary to restart the pumping equipment. Mobile generators are practical for remote or regional facilities where electrical power failure does not pose an immediate threat of flooding. Since the system is mobile, with its own control panel and fuel tank equipped trailer, it can be transported to the site of the power failure and connected to the main controls. The mobile generator may also be used as a standby power source for other activities when not in service at a pumping station.

D244

EVALUATION OF NEW REVERSE OSMOSIS MEMBRANES FOR THE SEPARATION OF TOXIC COMPOUNDS FROM WASTEWATER,

Chian, E. S. K., Aschauer, M. N., and Fang, H. H. P.

Illinois University,
Urbana,
Department of Environmental Engineering.

1976. 323 p, 69 fig, 56 tab, 122 ref, 5 append. NTIS Technical Report AD-A030-884.

Studies with NS-100 and aromatic polyamide membranes were conducted in an attempt to select reverse osmosis membrane materials for use in the treatment of waste water from army field hospitals. Mathematical models were formulated for optimizing the casting conditions for flat sheet NS-100 membranes. Membrane performance was predicted under various operating conditions. NS-100's surface structure was related to its capacity to retain organic compounds using a simple test with a sodium chloride solution. The potential application of both NS-100 and aromatic polyamide membranes, including B-9 and B-10 permeators, was examined for other waste water types. An additional objective was to evaluate the engineering parameters involved in applying NS-100 membranes to the treatment of waste water. Casting techniques for tubular NS-100 membranes were also refined. NS-100's chemical resistance to oxidants and the effects of additives on membrane performance were evaluated. A computer program was developed for use in the design of large treatment plants using the results from tests on single tubes or tubular membrane modules.

D245

LONG-TERM PERFORMANCE OF A COUPLED TRICKLING FILTER-ACTIVATED SLUDGE PLANT,

Stenquist, R. J., Parker, D. S., Loftin, W. E., and Brenner, R. C.

Brown and Caldwell,
Walnut Creek, California.

Journal Water Pollution Control Federation, Vol. 49, No. 1, p 2265-2284, November, 1977. 15 fig, 10 tab, 8 ref.

The upgrading of the Livermore Water Reclamation Plant in Livermore, California, and its operation and performance from its startup in early 1967 through its seventh full year of operation in 1974 are reviewed. The expansion involved increased influent and primary effluent pumping capacity, addition of a secondary trickling filter, conversion of the existing secondary sedimentation tank to a primary tank, and increased disinfection capacity. Use of the coupled trickling filter-activated sludge process has resulted in the consistent production of an effluent low in BOD, suspended solids, ammonia, and coliform bacteria. Operational problems appeared to be correctable through newer design techniques. Plants of similar design have either been or are now being constructed in San Pablo and Lompoc, California, and in Corvallis, Oregon.

D246

TREATMENT OF THERMALLY-CONDITIONED SLUDGE LIQUORS,

Loll, U.

Institut fuer Wassersorgung, Abwasserbeseitigung und Stadtbauwesen,
TH Darmstadt, West Germany.

Water Research, Vol. 11, No. 10, p 869-872, 1977. 3 fig, 2 tab, 12 ref.

Studies on the aerobic-thermophilic purification of undiluted filter effluents are described. The highly concentrated substrates from the dewatering of thermally-conditioned sludges were biologically treated with aerobic-thermophilic processes in batch and continuous systems. Process performance was assessed according to reductions in COD, BOD, total organic carbon, and volatile solids. Temperature, pH, total phosphorus, and ammonia-nitrogen were also measured. The studies indicated that reductions in COD of up to 71% and in BOD of up to 96% were possible. Exothermal processes in the reactor resulted in an effluent temperature of about 25 C, compared to an influent temperature of about 17-18 C.

D247

WASTE TREATMENT,

Canadian Chemical Processing, Vol. 61, No. 11, p 4-5, 1977.

Rapid changes occurring in waste treatment due to the use of new reactor designs are cited. The new reactors are more compact than conventional oxidation tanks and are better suited for handling wastes during cold weather. A recent development is the Oxitron process which uses the upward flow of effluent through a sand bed to fluidize the sand. Bacteria coating each grain of sand metabolize wastes in the stream. Pure oxygen is injected into the solution. The Oxitron reactor occupies 10-20% of the land area required for conventional aeration tank designs. Another compact waste treatment system is the Wetox process, a wet-air oxidation process which decomposes organics in the waste stream. For small plants, requiring less than 20 mg oxygen per day, a pressure-swing adsorption system is economical. Large plants can use less expensive, cryogenic air separation. New technology and regulations on sludge utilization and disposal will be reviewed in a seminar being sponsored by Environment Canada and the Ontario Ministry of the Environment to be held in Toronto in February 1978.

D248

A FIELD STUDY OF THE AGRICULTURAL USE OF SEWAGE SLUDGE: III. EFFECT ON UPTAKE AND EXTRACTABILITY OF SLUDGE-BORNE METALS,

Kelling, K. A., Keeney, D. R., Walsh, L. M., and Ryan, J. A.

Ball State University,
Muncie, Indiana,
Department of Natural Resources.

Journal of Environmental Quality, Vol. 6, No. 4, p 352-358, October-December, 1977. 7 tab, 27 ref.

The uptake of Cu, Zn, Cd, Ni, and Cr by rye, corn, stover, and sorghum-sudan plant tissue was evaluated in studies on the effects of the application of anaerobically-digested sewage sludge to croplands. Cu, Zn, Ni, and Cr were measured in the plant tissue and the DTPA-extractable fraction of the sludge-amended soil. Liquid sludge was applied to a sandy loam and a silt loam at rates up to 60 metric tons/ha on a dry solids basis. Although sludge additions had little effect on the heavy metal content of corn grain, elevated concentrations of Zn, Cd, and Ni were detected in plant tissue. Cr was not detected in either tissue or grain. The concentrations of the metals were under levels considered harmful to crops in all cases. The total recovery of the applied metals by all four crops was under 1% for Cu, Cd, Ni, and Cr; 1-3% of the applied Zn was recovered. The addition of metal-bearing sludge increased the DTPA-extractable fractions of Cu, Zn, Cd, and Ni, but not Cr. Regression analyses suggested that the quantity of heavy metal in the DTPA-extractable of soil may be a useful indicator of the heavy metal content of plant tissue from sludge-amended soils.

D249
HYACINTHS FOR WASTEWATER TREATMENT,

Joseph, J.

Plumbing Engineer, Vol. 5, No. 6, p 14-16, November-December, 1977.

The use of water hyacinths has been proposed as a low-cost means of waste water treatment. Water hyacinths absorb contaminants from water which can be recovered upon harvesting. The harvested plants can be used as supplemental animal feed or converted into methane and fertilizer by composting. Results from a test facility in Orange Grove, Mississippi, using hyacinths to treat raw sewage from a community of 5000 residents indicate that water hyacinths can be used for final polishing to produce effluent of a quality which complies with advanced waste water treatment standards. A treatment facility designed to use water hyacinths generally consists of treatment lagoons and aeration, filtration, and plumbing equipment. Costs for operation and maintenance are generally low. Waste water is first held in an aerated basin for a two-week period to allow bacterial consumption of the waste water organics. The final filtration lagoon, planted with water hyacinths, can usually be smaller than the aeration basin because of its higher efficiency. The water hyacinth lagoon at Orange Grove, Mississippi, effectively reduces the concentration of suspended solids in effluent by 63-80% and nitrogen by about 60%.

D250
LOW-FLOW WASTE WATER TREATMENT,

Rain, Vol. 4, No. 3, p 6-7, December, 1977. 7 fig.

A simple treatment system for low volumes of waste water with few suspended solids is based on the use of a 30-gal garbage can as a settling tank to trap floatables which would clog the seepage pit. When floatables and grease appear in a 5-gal plastic bucket used as a check tank, the settling tank should be emptied and the contents buried. A sand filter made from a 55-gal drum can be used to treat 25-50 gal of greywater per day. Because sand filters may fail if continually saturated, the alternate use of two filters is recommended. One direct surface application system is designed to retain urine and greywater in a 55-gal drum for use as irrigation water with a fertilizer value. The end of the hose carrying the waste water to the garden is covered by a cloth bag for retention of large particles. Systems have been designed for treating 20-50 gal of greywater daily using tar-covered, 55-gal drums. The leach line for one such system uses a 'V' made of redwood or cedar instead of plastic or tile pipe. A system for reusing greywater is designed to send all sewage directly to the sewer when a valve is closed and to a holding tank when the valve is open.

D251
GREYWATER TREATMENT,

Rain, Vol. 4, No. 3, p 4-5, December, 1977. 1 fig.

Separate treatment of toilet wastes and kitchen garbage by composting can reduce the extent of treatment required for the remaining greywater. Separate treatment and water-conserving measures can reduce domestic waste water treatment needs sufficiently to allow the use of simple treatment systems installed and maintained by the homeowner. These simple systems can cost much less than central septic-leach systems. They typically return water to the water table in small doses. Their disadvantages are generally related to the lack of experience and inadequate standards. Because construction standards vary widely and have a poor compliance record, regulatory agencies are usually reluctant to accept these systems. Treatment requirements for greywater are generally dependent upon the waste water volume, its strength, and the intent for reuse. It is very difficult to determine the nature of health hazards associated with greywater treatment.

D252
TRENDS EMERGE, BUT SOLAR DESIGN OPTIONS STILL OPEN,

Mungovan, J. A.

Modern Metals,
Chicago, Illinois.

Modern Metals, Vol. 33, No. 10, p 22-24, 26, November, 1977. 3 fig.

A new plant for waste water treatment in Wilton, Maine, will obtain most of its energy requirements from solar collectors located on the southern exposure of the plant and from methane generated by the treatment processes. Due to federal and state participation, payback to Wilton will be about two yrs; the plant would require about 18 yrs to pay for itself without aid. The $2 million plant will use 54 double-glazed, copper-and-aluminum flat plate collectors supplied by Grumman Energy Systems. The energy demand of the equipment is low and the plant is designed so as to minimize heat loss. Fuel cost savings are expected to amount to $3594 annually; electricity cost savings should be $875 each year. This application of solar energy won the Owens-Corning Fiberglass Corporation Energy Conservation Award for 1975. Grumman Energy Systems' aluminum flat plate collector can be used interchangeably with its copper-and-aluminum flat plate collector in some applications.

D253

SANITARY DISTRICT SOLVES SLUDGE REMOVAL PROBLEM,

Water and Sewage Works, Vol. 124, No. 12, p 54-55, December, 1977. 3 fig.

The Los Angeles County Sanitary District has used flow aid devices to handle non-degradable wastes. The devices, usually used in industrial applications, included conveyor belt cleaners, pneumatic vibrators, and air cannons. The conveyor system, running at 100 ft/min, carries as much as nine tons of material per hour. The sticky material, which is removed periodically from the 31 digesters, is carried by 24-in wide rubber conveyors to hoppers for storage until it is hauled to a landfill. Three heavy-duty Clamp Mount Torsion Arm conveyor belt cleaners reduce manual cleanup requirements of the conveyor belts by 75%. The single blade counterbalance cleaners used previously had tended to bounce away from the moving belt when larger particles were encountered. Problems of waste buildup under the conveyor belt cleaners were solved with the installation of a small Martin Engineering Vibrolator ball-type vibrator on one of the dribble chutes. Six Martin Clamp Mount Torsion Arm belt cleaners have been ordered for the 36-in wide conveyor belts which handle centrifuge cakes. The installation of two Big Blaster air cannons on a waste loading hopper has made it possible to evacuate the hopper without prodding with a rod. The air cannons each expel 13.276 cu ft of air at 100 psig into the waste material through a 4-in diameter pipe.

D254

INFECTIOUS HOSPITAL WASTES: THEIR TREATMENT AND SANITARY DISPOSAL,

Block, S. S., and Netherton, J. C.

Florida University,
Gainesville,
Department of Chemical Engineering.

p 723-739, 3 fig, 3 tab, 44 ref. In: Disinfection, Sterilization, and Preservation, Block, S. S. (ed.), Lea and Febiger, Philadelphia, Pennsylvania, 1977. 1049 p.

The increased use of disposable items has increased the quantity of solid waste generated by hospitals. Hospital waste may be finely ground and discharged to a sewage treatment plant, incinerated, or landfilled. Wet grinding before discharge to the municipal sewage system is being considered for total hospital solid wastes. Tests for chloride, BOD, and COD revealed no significant changes in the sewage as a result. Most plastic and related materials should settle out or be removed during primary treatment. The waste should have little effect on the public health characteristics of the sewage, since material from bioscience laboratories is disposed of by grinding. Hospitals that use landfilling for most wastes generally use an incinerator for pathogenic wastes. Complete sterilization of incinerated wastes requires a proper combination of air temperature, firebrick temperature, and retention time. Land disposal may expose the community to hospital waste contaminants, with the greatest potential of exposure arising from a disposal site where water pollution by runoff or leaching may occur. Wastes should be ground and sterilized before land disposal. High fecal coliform densities sampled from a landfill (2000 to 4,900,000 organisms per 100 ml) indicate potential health effects during the first 2-month leaching period. The absence of pathogens in the leachate confirms that pathogens are inactivated by heat in the landfill.

D255

EFFECTS OF INCUBATION AND LIMING ON YIELD AND HEAVY METAL UPTAKE BY RYE FROM SEWAGE-SLUDGED SOIL,

Lagerwerff, J. V., Biersdorf, G. T., Milberg, R. P., and Brower, D. L.

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United States Department of Agriculture-Agricultural Research Service,
Beltsville, Maryland.

Journal of Environmental Quality, Vol. 6, No. 4, p 427-431, October-December, 1977. 3 fig, 4 tab, 12 ref.

Rye (Secale cereale) was greenhouse-grown in sandy loam fertilized with digested secondary sludge in studies to evaluate the yield and uptake of Cd, Cu, Pb, and Zn as a function of sludge origin, pH, incubation time between mixing and planting, and plant age. Sludge application rates of 0-10% on a dry weight basis and incubation times ranging 0-7 weeks were used. The effects of sludge obtained from Baltimore, Maryland, and Washington, District of Columbia, were compared. Comparisons of three successive clippings revealed that plant yields decreased at higher sludge application rates. Metal uptake increased with sludge addition and with plant age, with the effect being greatest for Zn, followed by Pb and Cu. With the addition of lime, the uptake of Zn from sludge decreased, followed by Cd, Pb, and Cu. The uptake of Cu and Pb significantly decreased with incubation. The data suggested that the tendency to form organic complexes was greater for Cu than for Pb, Zn, and Cd. The relative uptake of HCL-extractable Cd from the soil was greater than that of Zn, especially upon liming.

D256
A FIELD STUDY OF THE AGRICULTURAL USE OF SEWAGE SLUDGE: II. EFFECT ON SOIL N AND P,

Kelling, K. A., Walsh, L. M., Keeney, D. R., Ryan, J. A., and Peterson, A. E.

Ball State University,
Muncie, Indiana,
Department of Natural Resources.

Journal of Environmental Quality, Vol. 6, No. 4, p 345-352, October-December, 1977. 3 fig, 5 tab, 25 ref.

Changes in concentrations of soil inorganic N, organic N, and available P with time were examined at field sites in Arlington and Janesville, Wisconsin, which had been treated with digested sludge. Liquid digested sludge applied at rates of 3.75-60 metric tons/ha increased the concentrations of inorganic N, organic N, and available P in the sandy loam and silt loam soils. Most of the inorganic N in the digested sludge was in the form of NH4-N and was rapidly nitrified. At application rates of 30 metric tons/ha or higher, substantial amounts of sludge-applied N were lost by leaching. Concentrations of NO3-N in the soil water were over 100 mg/liter at a depth of 120-150 cm within 10 weeks after sludge application on permeable sandy loam and within about 1 year after application on silt loam. The N balance indicated that considerable N might have been lost via denitrification or volatilization at application rates over 30 metric tons/ha. As much as 50% of the organic N in the sludge was mineralized by 3 weeks after application, more than previously reported. During the following 25 months, the mineralization rate essentially remained at about 250 mg of organic N/kg of soil/year where 60 metric ton/ha had been applied and at 180 mg of organic N/kg of soil/year where 30 metric ton/ha had been applied. Sludge applications immediately increased the quantity of available P. The quantity of available P subsequently decreased with time, probably due to P fixation. Where higher treatment rates had been used, significant amounts of available P remained in the soil after 2 years.

D257
DOMESTIC WASTE WATER RECYCLING,

Engineering News-Record, Vol. 199, No. 20, p 54, November, 1977.

Purecycle, of Boulder, Colorado, has developed a 5-step process for purifying domestic waste water for recycling. The recycling module is controlled and monitored by sensors connected to a microprocessor. The recycling module would be installed outside the house and connected with existing plumbing. Its size is approximately that of a compact car, and its costs will be comparable to those of conventional systems. Household waste water enters a biological reactor for the oxidation of organics; solids are removed by settling. The water then enters a filtration system and an organic adsorption unit, followed by a demineralizer and sterilizer. The microprocessor monitors the system for malfunctions. According to the manufacturer, tests have indicated that the system can produce a constant and safe recycled water supply at reasonable cost.

D258

CHEMICAL INTERACTION IN PARTICLE SEPARATION,

Stumm, W.

Swiss Federal Institute of Technology,
Zurich, Switzerland.

Environmental Science and Technology, Vol. 11, No. 12, p 1066-1070, 1977. 8 fig, 8 ref.

Chemical interaction in particle separation is discussed with respect to solution variables which may influence the charge of colloidal surfaces. The specific adsorption of Mg(++), H(+), heavy metals, and anions such as SO4(--), HPO4(--), SiO, OH3(-), and OH(-) onto hydrous oxides of Si, Al(+3), and Fe(+3) is examined with respect to the resultant electric charge on the particle surface. The relative efficiencies of particle aggregation in coagulation and particle removal in filtration are compared for natural systems and waste water treatment processes. Mechanisms of phosphate removal during sewage treatment by precipitation with Fe(+3) or Al(+3) salts are discussed.

D259

FILTER TOWERS AND DISTRIBUTORS FOR LLANDYRNOG SEWAGE TREATMENT WORKS,

Industrial and Metallurgical Equipment Limited,
Wettern House, Dingwall Road, Croydon,
Surrey, England.

Water Services, Vol. 81, No. 979, p 565, September, 1977. 1 fig.

The use of two filter towers and four motorized Carlton distributors at the Llandyrnog sewage treatment works in Scotland is described. The distributors were designed to provide a 60% reduction in BOD by ADF treatment over Flocor filter media. Two thirds of the influent BOD is contributed by creamery waste and one third by domestic sewage. The initial raw sewage inflow is screened to remove extraneous matter and grit. Pumps are then employed to feed the liquor to the filter tower distributors. The liquor percolates through Flocor media prior to sedimentation. Corrosion resistant stainless steel distributing arms are design features of the machines. The motorized Carlton distributors are used for secondary filtration operations on a 19.5-m diam and a 23.35-m diam filter bed. An important feature in the design is the frictionless liquid seal, achieved by immersing the open ends of the pending siphons in the liquid remaining at the bottom of the revolving tank.

D260
CHLORINATION AND OZONATION IN WATER AND WASTEWATER TREATMENT,

Keenan, J. D., and Hegemann, D. A.

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Philadelphia,
Department of Civil and Urban Engineering.

Chemosphere, Vol. 7, No. 1, p 9-28, 1978. 2 fig, 51 ref.

An evaluation based on chemical and biological factors cited in previous studies of chlorine and ozone as disinfection agents of waste water and potable water was presented. Chlorination of potable water was effective for the removal of tastes, odors, color, iron, and manganese. Chlorine was also found to control algal growth, slime growth, and hydrogen sulfide, and to improve activated silica precipitation. Studies in which the use of chlorine in waste water treatment was shown to produce potentially toxic chlorinated organics were cited. The production of chlorinated organics in waste water was considered more serious than in potable water because of the larger number and concentrations of organics in waste water. Dechlorination was considered an expensive remedy for the effects of chlorination. Ozonation of waste water was found effective in the reduction of fecal coliform counts, odor, color, turbidity, organic pesticides, and the conversion of cyanide to a biodegradable level. Treatment with 60 ppm of ozone was required to reduce BOD levels; COD was reduced with more conventional ozone concentrations. Costs for ozonation and chlorination of waste water appeared compatible. An analysis of the chemical reactions occurring during ozonation and chlorination was presented.

D261
ROTATING BIOLOGICAL CONTACTORS TREAT ISLAND'S SALINE SEWAGE,

Water and Sewage Works, Vol. 125, No. 2, p 62-66, February, 1978. 5 fig, 4 tab, 10 ref.

The performance of a compact, low power biological contactor that functions as both an activated sludge reactor and a trickling filter for the South Pacific island of Kwajalein was simulated in pilot studies at the University of Rhode Island. The highly saline Kwajalein sewage effluent was monitored for BOD, chloride, total and volatile suspended solids, nitrogen, and phosphorus. Organic overloading could be controlled by recirculation of 50% of the effluent to reduce BOD and prevent trickling filter failure. Recirculation was effective at organic loadings exceeding 3.3-4.0 lbs BOD/1000 sq ft/day. Low mixed liquor suspended solid levels ranging 100-215 mg/liter with a hydraulic contact time of 1-3 hrs, allowed both the activated sludge and trickling filter processes to function. A decrease in biooxidation by the filter during intense storms could be counteracted by increasing the mixed liquor suspended solids concentration to 2,000 mg/liter. Higher hydraulic loadings were effective with low BOD effluent. Removal of 50% of the nitrogen from the effluent was realized for a sewage nitrogen concentration of 4.5 mg/liter.

D262

WATER RECLAMATION AND RECYCLING,

Kavanagh, M. D.

Chartered Municipal Engineer, Vol. 105, No. 1, p 7-14, January, 1978. 6 fig, 5 tab, 9 ref.

Water recycling and reclamation practices are reviewed f r municipal and industrial wastes and water supplies. A study of the River Exe in England revealed that the river's water was reused three times through removal for municipal water supplies and discharge from treatment plants. A total of 92,901 cu m was removed and 70,038 cu m discharged daily as indicated by licensed uses of the River Exe. Fifty sewage treatment plants are located within the River Exe basin. Research and methods for the recycling of sewage for potable water supplies are discussed. Industrial plants have the option of treating their own wastes or discharging them to municipal or regional waste treatment plants. The latter alternative involves a surcharge tax for discharge or a contribution to treatment plant construction and operation, eliminating discharge costs. In-plant industrial treatment processes were examined at a cement company which recovers materials from its concrete mixer, using recycled water at a significant savings. The reuse of municipal sewage for industrial cooling was cited for electrical powerplants, steel manufacturers, gas production, and food processing industries.

D263

SLUDGE DEHYDRATION BY MEANS OF CHAMBER FILTER PRESS (Slamavvanning med kammerfilterpresser),

From, J. O.

Teknisk Ukeblad, Vol. 124, No. 5, p 42-44, October, 1977. 2 fig.

Principles, advantages, and experimental results on the use of chamber filter presses for dewatering sewage sludge are presented. Chamber filter presses have the advantage of being sturdy, simple to operate, and dependable. They do not require the use of synthetic polyelectrolytes for sludge conditioning, although ferric chloride and lime may be used in pretreatment. Sludge from physico-chemical waste water treatment plants can be dewatered in chamber filter presses without liming. The filter cake, with a solids content of 30-40%, can be incinerated directly without further treatment. Experiments in Norway with chamber filter presses operated at a specific load ranging 60-150 liters/sq m/hr produced a filter cake with a solids content ranging 26-35%. Residual solids on the filter cloth could be removed by treatment with hydrochloric acid.

D264

FILTERS FOR SCOTTISH SEWAGE PURIFICATION PLANT,

Water Services, Vol. 81, No. 979, p 558, September, 1977.

Two rotary drum vacuum filters, manufactured by Stockdale Engineering Ltd. of Rockbank, Macclesfield, Cheshire, England, are being used in Scotland to dewater a mixture of primary and secondary sludge at a waste water treatment plant which handles municipal wastes in addition to effluents from a distillery and a vegetable cannery. The sludge, which varies in pH from 4.0 to 11.0, is conditioned by the addition of a slurry of lime and aluminum chlorohydrate. After conditioning, the sludge is fed by gravity to two 300 sq ft Stockdale filters. The resulting filter cake containing about 20% solids is discharged into skips for transport to a landfill.

D265

MEMBRANE SEPARATION PROCESS--PRINCIPLES, PRACTICE, AND PROSPECTS,

Meares, P.

Aberdeen University,
Scotland,
Department of Chemistry.

Interdisciplinary Science Reviews, Vol. 2, No. 4, p 327-336, 1977. 2 fig, 6 tab, 21 ref.

Various membrane processes for separation at the molecular level and for desalination, hyperfiltration, waste water treatment, and gas separation are discussed. Some polymers and rubber-like elastomers have varying molecular chain configurations which allow the pore size to change. Rigid polymers with crystalline molecular chains and pores less than five nanometers in diameter are formed by the combination of a cationic and an anionic polyelectrolyte or by combined solvent and non-solvent casting. These rigid polymers, which can become plasticized by large quantities of permeants, allow small molecules to penetrate the pores but exclude the macromolecules, making these membranes useful in dialysis and ultrafiltration. The primary processes of desalination are reverse osmosis and filtration with gel membranes used in electrodialysis and piezodialysis. Hyperfiltration with cellulose acetate membranes is effective in desalination but could be improved by the development of less bulky polymer chains and hydrogen-bonding groups. Desalination through electrodialysis utilized cationic and anionic exchange resins and electric generation. Polarization and organic fouling of the membranes inhibit the effectiveness of electrodialysis. Piezodialysis, regarded as the best method for desalination, utilizes ion and water flow coupling, and allows salt to permeate the membrane under pressure while water is absorbed. The most permeable polymer in use for separation of nitrogen and oxygen from gaseous products was found to be a dimethyl silicone membrane. While permeability was high in comparison with other membranes, selectivity was low.

D266

HAYLE VALLEY STW--BIGGEST IN CORNWALL,

Water Services, Vol. 81, No. 979, p 570-572, September, 1977. 7 fig.

The Hayle valley sewage treatment plant in the West Cornwall area of England was designed to serve a summer population of 37,500 and a winter population of 19,000. Raw sewage is first screened and grit is removed by two 5 m-diam Pista grit traps. The sludge then undergoes primary settling in three 27 m diam, 3.5 m-deep basins. Effluent from a local creamery, which the plant also treats, is pumped to a 230 cu m holding tank and then to a primary tower filter containing 1200 cu m of Flocor E. Two screw pumps transport the flow to primary humus tanks, secondary biological filters containing granite media, and secondary humus tanks. Sludges are treated with a polyelectrolyte and dewatered by two Manor-Guwa tower presses.

D267

WHITHER AUTOMATIC CONTROL IN THE SEWAGE TREATMENT FIELD,

Thurley, L.

Kent Instruments Limited,
Luton, England.

Water Services, Vol. 81, No. 981, p 693-696, November, 1977. 2 fig.

The expansion and automation of waste water treatment facilities with analog discrete units or digital processors to meet effluent standards are discussed. Analog units include a flow control loop that operates a statutory recorder with a penstock to restrict the flow of storm runoff. A monitor for the coarse and fine screens can activate a rake mechanism or additional screening. Isolation penstocks with relay circuitry control the velocity in the grit separator with additional flumes, detritors, or macerators. Analog principles or inflow channel flumes are used to equalize the flow of waste into the primary sedimentation tanks. An ultrasonic sludge level detector regulates the hydrostatic removal of sludge on a time or suspended solids basis. The activated sludge controls involve a magnetic flow controller and detector head or a flow summation monitor of individual activated sludge channels. Mackereth probes are used for dissolved oxygen level monitoring. Preset digital processors automatically control the storm water inflow, primary sedimentation, and final sedimentation. Screens and detritors are automatically activated in sequential order according to flow rate. The handling, treatment, and disposal of sludge is more efficiently handled with the aid of visual and printed data from the digital processors.

D268

HORSHAM'S NEW STW HANDLES INCREASING POPULATION,

Water Services, Vol. 81, No. 981, p 705-706, 708-709, November, 1977. 1 fig.

The new municipal waste water treatment plant in Horsham, Sussex, England, with a daily effluent load of 335,000 liters and a BOD load of 415 kg, was constructed to alleviate the 342% overload on the existing facilities. The inlet works and pumping station, with three screw pumps, have a capacity of 2,680 liters/sec; an additional pump with a 1,320 liter/sec capacity is planned. Two storm water tanks were constructed with space provisions for two additional storm water holding tanks. Sewage effluent is mechanically screened and then hydrostatically desludged in two sedimentation tanks. Four biological filters are operated with alternate double filtration. Effluent is further treated by two interchangeable primary and two secondary humus tanks which return effluent to the secondary biological filters. Two sludge holding tanks dewater sludge that is conditioned with a polyelectrolyte and pressed by horizontal filter belts. Flowmeters monitor effluent and activate diesel generators for alternate power sources in the event of a power failure. Treated effluent is discharged into the River Arun through three outfalls.

D269

TREATMENT PLANT AND PIPELINES FLOW CONTROLLED BY MINICOMPUTER SYSTEM,

Water Services, Vol. 81, No. 981, p 700-701, November, 1977. 2 fig.

The largest municipal waste treatment facility in the Netherlands, located in Eindhoven, is controlled by a Philips P800-series minicomputer with telemetry links. The Eindhoven facility, with a population capacity of 750,000, also receives sewage from several southern villages via a 46 km long pipeline. The treatment processes, including bar screening, grit removal, primary and secondary sedimentation, aeration, and sludge pumping, are monitored and controlled by a computer system which furnishes visual and printed information on levels, flows, motor currents, and operating times. Six pumps, controlled by the computer's monitoring of the waste levels in the supply channels, have been installed to optimize pumping operations between the bar screens and the grit chamber. Dissolved oxygen levels in the three aeration basins are maintained by 24 loops controlled by the computer. Excess sludge pumping and routing to another treatment facility, as well as measurement of effluent quality parameters at the discharge point, are controlled by the computer. A Philips RL 200 time division multiplex telemetry system relays pipeline information to the central control room at the treatment facility. Based upon the pipeline data, the computer provides optimal use of the buffer in the pipeline and prevents or reroutes overflows.

D270
AGENCY SOUGHT FOR CANADIAN DOMESTIC UNIT,

Water and Waste Treatment, Vol. 21, No. 1, p 17, January, 1978.

A domestic sewage treatment unit that produces purified water and non-odorous sludge has been developed for distribution in England by Waltec Industries Limited of Penctanguishene, Ontario, Canada. The 'Aquarobic' unit, intended as a replacement for domestic septic tanks, consists of a 600-gal fiberglass aeration tank and a 90-gal settling basin. The system utilizes aeration and microbial degradation to purify waste water. Excess air is introduced into the raw waste by an electro-mechanical pump. Aerobic microorganisms consume the carbon-bearing pollutants in the sewage, producing carbon dioxide and inert chemical ash. The waste water is passed through a sand filter before discharge into the surrounding land. The sludge can be contained in the tank for a period of up to eight years before removal is required. The unit has a capacity of 400 gal/day and requires 0.39 kilowatts/hour electrical power for operation of the air supply pump.

D271
SAFETY INTERLOCKING AT SEWAGE WORKS,

Water and Waste Treatment, Vol. 21, No. 1, p 22, January, 1978.

Castell Locks, a European safety interlocking manufacturer, has developed a safety lock system for waste water treatment plants. Full-scale testing of the system was conducted at a treatment plant in Wolverhampton, England. Six biological filter beds were equipped with power isolators and interlocks which prevent access to the beds when the electric current is connected. A Castell switch isolates the power supply to the beds, releasing a key when the switch is activated. The key releases the interlocks on the access doors and cannot be removed while the door is open. This safety precaution prevents the connection of the filter bed with the electrical power source. Each access door to the filter beds requires its own key, preventing access to one filter bed with the key from another. The system has been shown to be a cost-effective method of providing protection for plant personnel.

D272
NEW METHOD INJECTS SLUDGE INTO SOIL,

Water and Waste Treatment, Vol. 21, No. 1, p 17, January, 1978.

A technique has been developed for injecting sewage sludge and agricultural slurries several inches below the soil surface. The method, which was developed to eliminate the visual and odor pollution resulting from land applications of sewage effluent, utilizes a slave tanker equipped with sludge injection tubes. Two coulter discs and tines, mounted on the tanker, open a furrow into which sludge is injected through tubes attached to the backs of the tines.

Two pairs of spring plates replace the ground over the sludge. This technique allows for the application of sludge on steeper gradients and reduces nitrogen loss from the sludge in the soil. On-site testing of the apparatus was conducted at the Anglian Water Authority's Great Billing works in England where 71% of the fertilizer used for agriculture is of sewage sludge origin. The process has been effective in the application of about 150 cu meters of digested sludge/sq acre of land at a rate of 1.8 cu m/min.

D273
DUTCH TREAT SEWAGE BY COMPUTER SYSTEM,

Processing, Vol. 24, No. 1, p 21, January, 1978. 2 fig.

A Philips P800-series minicomputer controls and monitors pipeline flows, water quality, and secondary treatment of sewage effluent at a municipal facility in Eindhoven, the Netherlands. The Eindhoven treatment facility, the largest waste water treatment plant in the Netherlands, receives effluent from six pumping stations conveying wastes along a 46 km pipeline. The computer controls the plant's treatment processes, including coarse screening, grit removal, primary sedimentation, aeration, secondary sedimentation, and sludge pumping. The computer has been able to optimize the pump operation between the coarse screening and the grit removal chamber by automatically activating the pumps in sequential order to maintain a desirable level of waste in the channel. Pipeline flow data are fed into the computer via a time-division multiplex telemetry system. The computer is able to provide optimum buffer capacity in the pipes and prevent or reroute overflows. Monitoring equipment records the pH, redox potential, dissolved oxygen, temperature, conductivity, and other parameters of effluent discharged into the Dommel River. Similar monitoring is conducted in the river above the point of discharge. The minicomputer furnishes a printout listing of water levels, flow rates, motor currents, operating hours, and other data.

D274
U.S.A. TRY RADIATION AGAIN,

Water and Waste Treatment, Vol. 20, No. 11, p 14, 16, November, 1977.

Pilot plant investigations of the treatment of dried or composted sludge with ionizing gamma radiation to reduce pathogen levels are being conducted at the Sandia Laboratories in Albuquerque, New Mexico. The dried or composted sludge may be used for fertilizer or soil conditioner if pathogen levels are sufficiently reduced by irradiation. Small lots of the sludge are exposed to one megacurie of cesium-137, a waste product of nuclear reactors, activated by photons of 10 million electron volts. The sludge will be exposed to the gamma radiation in doses ranging from several thousand rads to several million rads. Doses of one million rads or less are expected to sufficiently reduce the pathogen levels in the sludge. Experiments will also be conducted on raw and digested sludge which has been dewatered by air drying, centrifugation, or filter pressing. The cost of the irradiation procedure is estimated at $60-70 per dry ton of sludge.

D275

FINE FILTRATION OF WASTE WATER USING ROTO-KLAER (Feinsiebung von Abwaessern durch den ROTO-KLAER),

Schoettler, V. W., and Schinke, R.

Ingenieurberatung G. Morszeck,
Hameln, West Germany.

Fette-Seifen-Anstrichmittel, Vol. 79, No. 12, p 492-494, December, 1977. 1 fig.

Applications of the ROTO-KLAER filter, manufactured by the Noggerath Co., for clarification of sewage at municipal treatment plants are presented. The ROTO-KLAER is capable of filtering fine material from sewage with a drum sieve unit. The filtration unit replaces the conventional sand traps and preclarification basins. The need for strainer racks is also eliminated by the ROTO-KLAER filter. The elimination of sand traps, preclarification basins, and strainer racks compensates for the higher cost of the ROTO-KLAER drum sieve. The overloading of trickling filter plants can be avoided and processes improved with the installation of the drum sieve filter. Installation information and additional application of the filter are also presented.

D276

OXYGEN INJECTION AT WORK'S INLET,

Water and Waste Treatment, Vol. 21, No. 1, p 16, January, 1978.

An oxygen injection system, developed by BOC Ltd. of England, has eliminated the odor problem at the Holdenhurst Sewage Treatment Works in England. Odors emanating from the treatment facility during holiday seasons were controlled by the pilot installation of the Vitrox system at the inlet to the waste treatment plant. About three-quarters of a ton of oxygen is injected daily into sewage waste as it arrives at the plant. The Vitrox system was found to afford an additional advantage to that of odor elimination. The additional oxygen enhances the biological treatment and quality of the sewage effluent, which receives a total oxygen load of more than 2 tons/day. Plans are being completed for the permanent installation of an oxygen injection plant at the Holdenhurst treatment facility.

D277

EXPERIMENT TO PRODUCE COMMERCIAL SOIL CONDITIONER FROM SEWAGE SLUDGE PROVES SUCCESSFUL,

Water and Pollution Control, Vol. 116, No. 2, p 22, January, 1978.

A soil conditioner developed by Enrich Development Corporation of Delta, British Columbia, Canada, from sewage sludge produced by the Greater Vancouver Regional District's Iona Island waste treatment plant in Richmond is evaluated. The sludge is mixed with sawdust and composted in six- to eight-foot piles for two to three months. The stabilized, non-odorous composted sludge is then screened for the removal of large particles. Tests conducted with the soil fertilizer indicate increased plant growth and improved water retention by the soil. The soil conditioner, commercially marketed as 'Grow-Rich,' is suitable for use in agriculture, horticulture, landscaping, and lawn conditioning. Incineration of one dry ton of sludge by the waste treatment facilities costs about $100 while the cost of producing one dry ton of the fertilizer from sewage sludge is about $17. The Iona Island treatment plant produces about 370 cu yd/day of sludge. The market price of the soil conditioner is expected to be competitive with the price of truck-load top soil, which sells for $7-10/yd.

D278

HYGIENIZATION OF SEWAGE SLUDGE BY ELECTRON RADIATION,

Tofaute, K.

BBC Brown Boveri and Company Limited,
Baden, Switzerland.

Processing, Vol. 24, No. 1, p 22-23, January, 1978. 1 fig, 1 tab.

An electron irradiation process for the removal of pathogens from raw and digested sewage sludge has been developed by Brown Boveri and Company Ltd. of Baden, Switzerland. The first stage of the irradiation process requires the screening of the sludge for the removal of foreign particles and homogenization of the remaining particles to about 1 mm. The pretreated sludge is applied in a thin layer to a rotating drum containing the irradiation apparatus. Irradiation is accomplished with a high-voltage rectifier attached to an electron accelerator which contains electron-producing cathodes and a magnetic field through which the electrons are passed and deflected. The electron accelerator and scanner are operated in a vacuum. The irradiated, hygienized sludge is stored in a monitored, ventilated tank. Mortality rates of strains of Cole and Salmonella ranged from 10,000-100,000,000 with 300 krad irradiation; virus viability was reduced by 60-90%. The irradiated sludge was more easily settled and dewatered; coagulant requirements were reduced by as much as 50%. The irradiated sludge was more effective as a fertilizer than steam-pasteurized sludge. A review of capital and operational costs is presented.

D279
HONG KONG'S LARGEST SEWAGE WORKS,

Water and Waste Treatment, Vol. 21, No. 1, p 6-7, January, 1978.

A municipal sewage treatment plant currently under construction for Sha Tin near Hong Kong will have a daily capacity of 102,000 cu m of raw sewage when completed in 1980. The treatment facility, which will employ two physical treatment stages and one biological stage, will contain primary sedimentation tanks, aeration tanks, final settling tanks, sludge digestion and storage tanks, as well as a laboratory, an administration building, and a power generation building. The treatment facility will remove 92% of the pollutants in the sewage effluent before discharge into a landlocked harbor; provisions have been made for a tertiary treatment facility to protect the quality of the receiving harbor if necessary. The plant will receive a maximum flow of 3.6 cu m/second; biological treatment for nitrogen removal from the effluent will reduce the possibility of red tides in the harbor. The Sha Tin treatment facility, when fully developed, will be capable of treating sewage effluent from a population of 500,000.

D280
OZONE SHAKES CHLORINE'S HOLD ON DISINFECTION,

Remirez, R.

Chemical Engineering, Vol. 85, No. 4, p 59-61, February, 1978. 1 fig, 1 tab.

The transition from chlorine disinfection to ozone disinfection of sewage effluent by a number of waste water treatment facilities is discussed. Although the more expensive ozonation process requires constant gas dosages to prevent incomplete disinfection and toxin formation, chlorination can produce chlorinated organics which may be harmful to aquatic life. The relative expense of ozonation is reduced when the cost of dechlorination is required to eliminate harmful substances produced in the chlorine disinfection process. Sixteen municipal treatment facilites in the United States that employ ozone disinfection of waste water are cited. Union Carbide's UNOX/ozone system, which requires that oxygen be fed through the ozone generator only once, is evaluated for use in large treatment facilities. The alternative use of air rather than oxygen as a feedstock for ozone disinfection is discussed for large and small capacity treatment facilities.

D281

SHIELDHALL SEWAGE PURIFICATION WORKS--SPECIFICATION FOR AND SELECTION OF MECHANICAL EQUIPMENT AND PUMPS,

Buyers, J. S., and MacDonald, J.

Strain and Robertson, Consulting Engineers,
Glascow, Scotland.

Chartered Municipal Engineer, Vol. 104, No. 12, p 218-223, December, 1977.
4 fig.

Equipment and operational specifications for the design of a primary treatment facility in Shieldhall, Scotland, are reviewed. The plant will have an initial flow capacity of 48 mgd with provisions for expansion to a capacity of 60 mgd and for a secondary treatment facility. The two control centers for the treatment plant will be located in the presedimentation building and in the sludge pumphouse. A computer control system may be installed at a later date. Four identical low level screw pumps, each with a 980 liter/second capacity, pump influent to the presedimentation building which contains an oil boom, inclined bar screens, and grit dredging machines. Six main screw pumps with a 1580 liter/second capacity convey the flow to 12 primary treatment tanks, each equipped with a magnetic flowmeter, a gate valve, and an automatic scraper with a scum blade. Storm water is bypassed by two penstocks to storm tanks equipped with manually-operated scrapers. Sludge from the primary treatment tanks is discharged to an inspection chamber for analysis before it is transported by automatic sludge pumps to retention basins. Odor pollution will be controlled by filtration of process emissions through carbon. Sample contract checklists, safety factors, construction materials, and other related information are described.

D282

BELT PRESS BEATS SLUDGE DEWATERING PROBLEMS,

Processing, Vol. 23, No. 12, p 24-25, December, 1977. 2 fig, 1 tab.

A belt filter press, developed by Alfa-Laval Co Ltd, provides increased and prolonged pressure during the sludge dewatering process. The ecobelt system processes the sewage sludge through a drainage stage, a low-pressure section, and a high-pressure stage. The sludge is first flocculated with polyelectrolytes and passed through a drainage filter band for gravitational dewatering. The sludge is further dewatered as it is pressed by ploughs and rollers while passing horizontally through the drainage section. The resulting sludge cake, which has been dewatered by 50%, is passed between polyester filter bands mounted on perforated rollers with diminishing diameters within the low pressure zone of the process. Pressure on the sludge cake increases as the roller diameters decrease until the cake is passed into the high pressure stage controlled by two hydraulic cylinders. Pressure on the sludge cake is increased by flat belts that squeeze the sludge-bearing filter bands against a large perforated roller. The high pressure dewatering stage produces a final filter cake with a solids content 10% greater than sludge treated without the high pressure stage. Filter belts are subject to less wear because they are not over-extended; the filtrate and water removed during the process can be recycled. Suspended solids recovery with this process has ranged from 99% for raw and digested sludge to 9% for aluminum hydroxide sludge. Solids recovery averaged 95%.

D283

SEALING A SEWAGE LAGOON FOR HALF THE COST,

Brown, J.

Engineering and Contract Record, Vol. 91, No. 1, p 37, January, 1978.

Polymer-treated bentonite has been used instead of conventional materials for sewage lagoon linings at the White River sewage treatment plant in Ontario, Canada. The polymer-treated bentonite Volclay SG 40, supplied by American Colloid Co. of Lovell, Wyoming, swells to transform permeable, sandy soils into water-tight, sealed basins. The bentonite, when mixed with sand and water, doubles in size to form an impermeable seal, especially useful in swampy regions. A mixed blanket technique was used to apply the bentonite to the White River sewage lagoons. A 6.3 mm layer of the bentonite was applied to a section of the lagoon at a rate of 7.32 kg/cu meter. Two more layers, each 3 mm thick, were applied to the lagoon in opposing directions and the bentonite was raked into the sand to a depth of 50 mm and compacted. A 25 mm layer of SG 40 gel, a mixture of bentonite and water, was applied to the waste inlet at a depth of 609 mm to prevent erosion of the bentonite seal. One sewage lagoon required 227 tons of SG 40 using the mixed blanket technique.

D284

ENVIRONMENT GETS TOP TREATMENT IN HAWAIIAN SEWAGE OUTFALL JOB,

Western Construction, Vol. 53, No. 2, p 30, February, 1978.

A mobile ocean platform and explosive charges were employed in the construction of a sewage effluent outfall for Honolulu, Hawaii. The construction firm of Healy-Tibbitts utilized the Spider I offshore platform, which can transport equipment by walking along the ocean floor, to support excavation equipment. Shaped charges were required to break up the compacted coral on the sea floor in the outfall area. A 16-ft deep channel was blasted and 7,200 linear ft of material was excavated with a Lima 2400 crane and clamshell, a McKinnon-Tierney pile extractor, and a Cal-Weld hammer, all supported by the mobile platform. The outfall pipeline, ranging in diameter from 44 to 66 inches, contains a diffuser at the terminal of the outfall that discharges and disperses the sewage effluent at a depth of 100 ft. Divers were required to link the bell and spigot pipe sections and to set the explosive charges. The outfall will not be visible from the surface once the construction equipment is removed.

D285
CENTRALIZING SEWAGE TREATMENT IN DORSET,

Surveyor, Vol. 150, No. 4460, p 11-12, December, 1977.

A waste water treatment facility, with a capacity greater than 3 million liters/day and serving an area of more than 11 km, has been completed in the Dorset area of England. Flooding problems encountered in the floodplain of the Stour River where the main trunk sewer was installed were alleviated with wellpoint dewatering and sump pumps. Twenty-one kilometers of sewers and rising mains were constructed of asbestos cement or spun iron ranging 150-600 mm in diameter. The treatment plant, with a capacity of 2,818,520 liters/day of domestic and 385,420 liters/day of industrial effluent, reduces suspended solids to 30 mg/liter and BOD to 20 mg/liter by biological treatment. Storm water flows that exceed three times the dry weather flow are directed by penstocks to eight storm water tanks, each with a 365 cu m capacity. After grit is removed activated sludge is introduced to the influent as it is passed to the aeration chamber. Complete aeration and mixing is accomplished by a Mammoth Rotor controlled by a dissolved oxygen meter. Effluent is treated in three settling basins before discharge into the Stour River. Activated sludge is hydrostatically removed and a portion is returned to the initial activated sludge operation. The remainder of the sludge is thickened in a 7.6-m tank with a picket-fence stirrer and removed to a holding tank for disposal.

D286
SEPTAGE COMPOSTING,

Lombardo, P.

Pio Lombardo and Associates,
Environmental Engineers-Planners,
Boston, Massachusetts.

Compost Science, Vol. 18, No. 6, p 12-14, November-December, 1977. 4 fig, 2 tab, 5 ref.

Pilot plant studies were conducted in Rehoboth, Massachusetts, to evaluate the treatment of domestic wastes from septic tanks by aerated and static pile composting with sawdust, woodchips, and animal manure. The dumping of septic wastes from three towns in the municipal waste treatment facility was prohibited because of the quantities of suspended, volatile, and total solids, as well as mean BOD and COD concentrations of 5,000 mg/liter and 45,000 mg/liter, respectively. Composting treatment of the septic wastes was preferred over chlorination, chemical treatment, anaerobic or aerobic treatment, lagooning, sand drying, land application, and disposal in a waste treatment facility or sanitary landfill. The high moisture content of the waste was reduced by the addition of sawdust and woodchips for moisture absorption; nitrogen was supplied by manure. Forced aeration and static pile composting were used at an asphalt drainage site. After manual mixing, the compost reached a maximum temperature of 163 F at 5-10 days after pile construction. The estimated cost of a composting facility with a daily capacity of 15,000 gal from the three towns was $240,000.

D287

USING PLANTS FOR WASTEWATER TREATMENT,

Golueke, C. G.

California University,
Berkeley,
Sanitary Engineering Research Laboratory.

Compost Science, Vol. 18, No. 5, p 16-20, September-October, 1977. 1 tab, 7 ref.

Waste water treatment systems using algae, duckweed, and water hyacinths were evaluated for pollutant conversion or removal capabilities, ease of harvesting, and potential food or fertilizer source. The use of algae in waste water treatment requires a symbiotic relationship with bacteria which break down the complex organic compounds to nutrients usable by the algae. Harvesting of the algae is difficult because of the microscopic size and low specific gravity of algae cells. The algae provide a source of protein for animal feed. The vascular, floating duckweeds are capable of doubling in quantity over 3-7 days in a semitropical climate by absorption of nutrients. These lemnaceae are easily harvested, but wind can cause large accumulations of colonies that decay. Dewatering of the duckweed would be required before use as an animal feed and oxalic acid concentrations must be considered. Emergent vascular plants, such as reeds and bulrushes, are grown in a bed containing sand and gravel upon which sewage effluent is applied. This method of treatment produces a clear, neutral effluent with low BOD concentrations and pathogenic bacteria counts but with residual phosphorus and nitrogen. Water hyacinths are capable of removing 80% of the nitrogen and 40% of the phosphorus, as well as amounts of potassium, calcium, magnesium, and sodium, from a sewage pond within a two day period. Vehicles from which harvesting operations are conducted are hindered by the masses of hyacinths in the water. The plants would have to be dewatered by 90-95% before use as an animal feed.

D288

MECHANIZED SLUDGE COMPOSTING AT DURHAM, NEW HAMPSHIRE,

Wolf, R.

Compost Science, Vol. 18, No. 6, p 25-26, November-December, 1977.

A municipal sewage treatment facility planned for Durham, New Hampshire, will combine a secondary treatment plant with a sludge composting facility located within the plant. An aerated pile composting system with woodchip amendments was chosen for the sludge treatment system. The filtered sludge and woodchip mixture will be stored and aerated for 21 days on a concrete pad outside the plant and will have channels and screens for mounting the aerators. The daily loading time required for processing the 30 cu yds of sewage sludge produced each day is estimated at one hour. Six employees will be required to run both the secondary treatment plant, costing more than $6 million, and the composting system, costing $600,000. Wood and brush deposited at the municipal incinerator will be shredded to provide woodchips for the sludge composting process. Sludge processing costs are estimated to decrease from the experimental $15/yd to $8/yd with woodchip production and reuse. The composted sludge will be sold for turf production, erosion control, and landscaping.

D289
A GRAYWATER SOIL TREATMENT SYSTEM,

Laak, R.

Connecticut University,
Storrs,
Department of Civil Engineering.

Compost Science, Vol. 18, No. 6, p 29-32, November-December, 1977. 2 fig, 4 tab, 23 ref, 1 append.

A pretreatment tank, an anaerobic upflow filter, and a leaching field system were developed for the separate treatment of domestic graywater. The pollutant parameters of gray water, comprising 40-70% of the total domestic waste flow, were considerably lower than those for combined sewage containing black water. The soluble BOD concentration of the gray water was higher than that of sewage. The required pretreatment tank capacity for a 6 person residence was calculated at 600 gal, providing a three year cleaning period for solids removal was established. Heat transfer to the surrounding soil and exit velocity reduction was accomplished by a tank length-to-width ratio of 3:1 and an inlet-outlet height difference of 0.1-0.2 m. Effective BOD and suspended solids reduction in the gray water after pretreatment was achieved by an anaerobic upflow filter. The fixed media filter reduced BOD levels in pretreated gray water from 150 mg/liter to 100 mg/liter and suspended solids from 120 mg/liter to 80 mg/liter. The treated gray water was then discharged into a leaching field that required a 40% smaller length and 50% smaller interface area than the conventional septic tank soil field. Phosphorus and nitrogen loading of the soil by gray water was six times less than that of septic wastes.

D290
BASIC SEWAGE TREATMENT FOR SMALL COMMUNITIES,

Water Services, Vol. 81, No. 982, p 760-761, December, 1977.

A compressed air-operated sewage ejector type pumping plant for rural use where small sewage volumes are encountered is described. The plant, manufactured by

Adams-Hydraulics Ltd, utilizes a 100 mm diameter pipe and valves; storage of sewage effluent is not required and clogging is avoided. The single or duplicate ejector systems of the duplicate centrifugal pumps are now available as prefabricated units, eliminating the need for constructing a permanent housing. The ejector system of the pumping plant, used in conjunction with settling tanks for full sewage treatment in isolated areas, is equipped with a rotary distributor providing overhead self-dosing and feed. An air release valve has been designed for use with sewage mains. The valve provides an 'in-line' flow pattern, as well as the conventional small and large orifices. The ejector can be located adjacent to the air compressor, which can be run on industrial air supplies in factories or at a distance from the air compressor plant.

D291

ORANGE COUNTY AUGMENTS WATER SUPPLY WITH RECLAMATION SYSTEM,

Water and Sewage Works, Vol. 125, No. 1, p 34-37, January, 1978. 1 fig, 1 tab.

A reverse osmosis-demineralization operation in Fountain Valley, California, provides high quality waste water which, when mixed with well water and injected into the ground, prevents sea water intrusion and supplements the county water supplies. Sewage effluent is initially treated in the municipal waste water treatment plant by chemical clarification, ammonia removal, recarbonation, filtration, activated carbon adsorption, and chlorine disinfection. Before reverse osmosis membrane filtration, the waste water is treated with scale inhibitors, cartridge filtration, chlorination, and pH adjustment. Dissolved minerals in the waste water are removed by the reverse osmosis system consisting of 210 cellulose acetate elements housed in fiberglass-reinforced plastic pressure tubes 21 ft long with 8 in diameters. After 90% mineral removal, the effluent is mixed with water obtained from four deep zone wells, each providing 2 million gal of water daily. The water mixture is injected into the groundwater through a series of 23 injection wells which distribute 10% of the water mixture to the ocean as a hydraulic barrier system. The reverse osmosis demineralization system, with a capacity of 2045 gal/min, cost $3 million and is the largest system of its kind in full operation.

D292

TRUCK-TANKERS CLEAN SEPTIC TANKS IN RURAL AREAS,

Dyment, R.

Water and Sewage Works, Vol. 125, No. 1, p 49, January, 1978.

A 4,000 gal sewage tanker truck is used by Rural Sanitation Service, Inc, of Clarence, New York, to clean septic and holding tanks in unsewered areas. Sewage is removed from the septic tanks by a rotary stainless steel Vane pump with continuous vacuum pressure. The rotor is equipped with sliding vanes mounted along the rotor's circumference. When the vanes are pushed outward by centrifugal force, the rotor casing is divided into separate compartments. The volumetric capacity of these compression compartments is maximized during rotation, causing air to be drawn in and compressed. Air is cleaned in the compressor by an oil filter and is prevented from flowing out through the air receiver by a non-return valve. Sewage pumped from the septic tanks to the tanker truck is removed either to a municipal treatment facility, a sanitary landfill, or to a farm where it is used in land applications. The sewage sludge is buried in trenches 8-10 inches below the field surface in batches of 1500 gal for land fertilization.

D293

SEWAGE ODOR CONTROL WORKS IN BELOIT, WISCONSIN,

Bryson, J. D., Davis, C. A., and Zuicarelli, F. J.

Will Ross, Incorporated,
Milwaukee, Wisconsin.

Water and Sewage Works, Vol. 125, No. 1, p 82-83, January, 1978.

An electrical deodorizer at the Beloit, Wisconsin, sewage treatment plant neutralizes odors produced in the clarifiers by mixing the gases with a dry vapor containing modified and natural oils and Neutrox Gamma, an aromatic compound. The inflow of odorous air into the unit's chamber is controlled by an aperture which allows the proper mixture of air with the dry vapor for neutralization. The dry vapor containing the special neutralizing formula is contained in cartridges which inject the adequate amount of vapor for neutralizing odors. The neutralizing unit replaced a biodigestor tank which was ineffective in the winter months and expensive to maintain. The level of odor in the contaminated air is sampled in monitoring inlets; dry vapor treatment is controlled by the odor contamination levels in the samples. Hydrogen sulfide and ammonia are the primary odor causing gases produced in the treatment facility. The total cost of the odor neutralizing unit, including 48 cartridges, was $2,585.

·D294

CAROUSEL FOR CIRENCESTER,

Water and Waste Treatment, Vol. 20, No. 12, p 31, 34, December, 1977. 1 fig.

A patented Carousel activated sludge aeration system has been installed in the new Cirencester sewage treatment plant in England which was designed to provide service for a population of 25,000. The English-Dutch Carousel treatment process provides extended aeration and activated sludge purification in a large tank containing four channels for circular aeration. Primary treatment consists of grit removal and screening, with solids removed to a landfill. After aeration, the effluent is pumped to settling tanks for sludge and liquid separation. The liquid is filtered in a land area for removal of dissolved nutrients and suspended solids. A screening unit will be installed to remove large solids such as plastics and rags from the sludge before application to agricultural land. The waste treatment plant is automatically controlled and requires only one attendant.

D295
FOOTPATH GOES THROUGH SEWAGE WORKS,

Water and Waste Treatment, Vol. 20, No. 12, p 35-37, December, 1977.

Piled foundations and combined treatment structures were incorporated into the design of the new municipal waste treatment facility at Saffron Walden, Essex, England. Pile foundations from 26-30 m deep were required to compensate for the unstable peat and alluvial soil upon which the 5.16 million liter/day treatment facility was constructed. The visual impact of the plant was modified by the construction of low profile structures. Treatment processes, such as the pumping operation and the effluent polishing microstrainers, were combined within the same structure to accomodate the restricted plant area. Influent is screened and degritted before passing to the primary settling basins. The four biological membrane filters required 325 concrete piles for foundation support. Two humus filters and two microstrainers provide secondary treatment and polishing. Sludge from the settling basins is thickened and retained in three storage tanks for landfill disposal or further treatment. Flows that exceed three times the dry weather flow are routed to storm water storage tanks for eventual treatment or overland flow filtration.

D296
UPRATING SEDIMENTATION TANKS,

Water and Waste Treatment, Vol. 20, No. 12, p 40, December, 1977. 5 fig.

A sedimentation tank adjunct, the TPS module developed by CJB Developments Ltd. of Portsmouth, England, enlarges the surface area in a humus tank for increased suspended solids flocculation without increasing tank volume. The stationary TPS unit is constructed of durable plastic. Suspended solids in the effluent descend through the module until they hit a series of spaced, inclined plates. The inclined plates direct the particles into corrugated plates containing troughs located beneath the inclined plates. As the solids collection in the trough increases, larger flocs with high settling velocities form. The settling rate of the flocs exceeds the upward flow rate of the incoming waste water. The TPS modules increase the settling capacity of upward flow humus tanks when installed just below the surface level. Horizontal flow tanks can be improved by installing the module in the second part of the tank with a baffle extended across the width to create an upward flow chamber. The TPS module was designed to correct flow conditions in overloaded tanks.

D297
80 ACTUATORS AT ONE WORKS,

Water and Waste Treatment, Vol. 20, No. 12, p 37, December, 1977.

The Penybont sewage treatment works at Ogmore-by-Sea, Wales, includes an automatic flow system controlled by Rotork motorized penstock and valve actuators. The treatment facility, which processes wastes that were formerly discharged directly into the Bristol Channel, has a present capacity of 12 mgd and a designed expansion up to 16-21.5 mgd. Over 80 Rotork actuators control all the valves and penstocks within the main treatment plant. The treatment facility has a capacity of 108 mgd storm water flow, of which 36 mgd receive full treatment while the rest is stored in settling tanks before discharge. The aeration tanks and the feedback channels from the storm water tanks are equipped with the Rotork valve actuators which provide fully automatic control. Rates of flow from the aeration tanks are automatically controlled by outlet weirs that operate according to the dissolved oxygen level in the activated sludge. Monitors also assess treatment capacity in the plant and channel stored storm water into the treatment process when capacity is not at maximum.

D298
DEODORIZATION MEASURES FOR NIGHT SOIL TREATMENT PLANTS (Shinyo shori shisetsu no dasshu taisaki ni tsuite),

Toyoda, F., and Chugo, M.

Ebara infiruko joho, No. 71, p 23-29, October, 1977. 6 fig, 7 tab, 2 ref.

Deodorization of sewage effluent gases with similar densities was evaluated for waste water treatment facilities using combined treatment processes. Deodorization techniques often employed are scrubbing, ozonation, adsorption, and incineration. Conventional deodorization methods treat gases from the different treatment processes together by one of the conventional methods. The combined treatment of gases was not considered adequately effective or economic. Odor-bearing gases produced during treatment in waste water facilities were collected and combined according to high, medium, or low density. These similar density gases were then deodorized by a combination of treatment methods applicable to the specific density characteristics of the gases. Although several types of equipment were required in the treatment plant, this method of deodorization was considered a more effective treatment technique.

D299
SEWAGE FARMING ... WHY IT MAY BE IN YOUR FUTURE,

The American City and County, Vol. 93, No. 1, p 48-49, January, 1978.

Land applications of treated sewage effluent by crop irrigation, rapid infiltration, and overland flow are evaluated and design loading rates are developed. The field size required for slow rate application by crop irrigation is dependent upon the hydraulic and nitrogen loadings. Hydraulic loading, the sum of all water uptake and loss rates, should not allow runoff. Rapid filtration applications are dependent upon the soil permeability and the percolation rate of waste water through the soil to the groundwater. Continuous infiltration of an area causes solids accumulation which governs the infiltration loadings. There is negligible crop uptake of water and nitrogen during rapid infiltration; nitrogen removal is controlled by nitrification and denitrification in the soil. Overland flow applications are limited when the slope of the area is more than 6%, the land area is less than 150 ft long in the direction of flow, or during cold periods when biological activity is low. Overland flow, in which waste water is treated by biological oxidation, sedimentation, and grass filtration, provides the lowest phosphorus removal of the three systems but achieves high BOD and suspended solids removal rates. Pretreatment measures suggested for all three processes are: solids and organics removal, as well as disinfection, for slow irrigation; solids removal for rapid infiltration; and extractable phosphorus improvement for overland flow.

D300

LET THEM EAT SEWAGE DOWN AT THE FISH FARM,

New Scientist, Vol. 77, No. 1085, p 70, January, 1978.

An estimated 1.4 million tons of dried sewage is disposed of each year in England, representing 1 million tons of primary treated effluent and 0.4 million tons secondary treated sewage. Primary effluent contains about 16% available protein; secondary sludge contains about 40% available protein. Sewage sludge is discussed as a possible source of food for the production of fish protein in fish farms. The supplemental feeding of sewage effluent to fish which are raised as a protein source for human consumption was suggested as an energy and food conserving measure. As an alternative to the direct feeding of sewage sludge to fish, it was suggested that feed worms and fly larvae be reared on the solid wastes. A food chain system such as this could produce an estimated 30 tons of fish/50 tons of sewage sludge. Although human consumption of the sewage-fed fish may not be acceptable, the fish could be marketable as fish meal in animal feeds.

D301

EFFLUENT AND WATER TREATMENT AT AERE HARWELL,

Lewis, J. B.

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Chemical Technology Division,
Atomic Energy Research Establishment
Harwell, England.

Effluent and Water Treatment Journal, Vol. 17, No. 7, p 348-351, July, 1977.

A sewage treatment installation at the Atomic Energy Research Establishment in Harwell, England, separates the various active and inactive waste flows and stores them for individual treatment. The daily water supply of 7,000 cu m is supplied from the Thames River by a water works 10 km away. Drainage systems installed at the research station separate into individual treatment tanks the surface and roof runoff, the domestic sewage, the inactive trade wastes from laboratories, workshops and cooling circuits, and the radioactive effluents. The surface runoff is checked for radioactivity before discharge into a land ditch near the treatment works. Treated domestic sewage is retained in holding tanks for radioactive testing before discharge into the land ditch. Sludge is treated with aluminum chlorohydrate, dried on sand filters, and buried nearby. Industrial wastes are clarified and chemically treated before discharge through a 10 km pipeline to the Thames River. The active wastes, containing between 0.0001-0.00001 microcuries of radioactive particles/ml, are pumped to two brick tanks for ferric hydroxide precipitation. The effluent is discharged to the Thames and the sludge is dewatered and buried in Cumbria. Radioactive effluent with levels higher than 0.0001 microcuries/ml is precipitated with calcium phosphate-ferric hydroxide or calcium phosphate-copper ferrocyanide.

D302

OVERALL OPTIMIZATION OF WATER PURIFICATION AND SLUDGE TREATMENT,

Tambo, N., Sato, A., Aya, H., Nambu, S., and Okamoto, S.

Environmental Research in Japan, 1976 Edition, 1977.

Water purification and sludge treatment methods involving filtration and coagulation were evaluated in laboratory tests, pilot plants, and full scale treatment facilities. The ratio of aluminum to suspended solids significantly affected the removal capacities of both rapid filtration and direct filtration processes. The efficiencies of both filtration processes were similar and considered more effective than sedimentation for the removal of suspended solids. The optimum pH range for the effective coagulation of both organic and inorganic substances was established as pH 6.0-6.5. Coagulation with aluminum sulfate and polyacrylamide was efficient in solids removal and sludge generation but breakthrough occurred during initial direct filtration. Sludge quality was significantly affected by the ratio of aluminum coagulant to suspended solids. The volatile solids content of the sludge significantly affected the sludge dewaterability. Lime was the preferred sludge conditioner for landfill disposal.

D303
ORGANIC FLOCCULANTS MARKET SET FOR BIG GROWTH,

Storck, W. J.

C and EN,
New York, New York.

Chemical Engineering News, Vol. 56, No. 4, p 9, 11, 1978.

The efficiency and economics of organic flocculants were compared to those of alum as a coagulant. Traditional coagulation chemicals are alum, lime, and some ferric or ferrous compounds. Organic flocculants such as polyamines, polyacrylamides, and polyepichlorohydrins are more efficient because of their electrical charge. Organic coagulants can be anionic, cationic, or nonionic polymers with mixed charges. A dose of 100 ppm of polymer can replace up to 1,000-5,000 of alum, although many plants are designed to handle the large sludge-producing alum or lime treatments. Alum costs about $129/ton, compared to polymers which may up to $2,700-5,000/ton. Polymers are preferred as flocculants over raw material monomers; they have the primary advantage of significantly reducing the production of sludge, a major disadvantage of alum and lime treatment.

D304
$30 MILLION ONE-MAN WASTE TREATMENT PLANT,

Journal of the Institution of Engineers (Australia), Vol. 49, No. 28, p 6, December, 1977.

A $30 million waste water treatment plant under construction at the mouth of Australia's Brisbane River will contain a digger elevator, an aluminum gantry, and a transfer carriage for the automated treatment of effluent from a population of 430,000. Municipal and industrial wastes are automatically screened upon entering the plant. The removed solids are pressed and incinerated and the waste water undergoes grit removal. The degritted effluent is subjected to primary sedimentation in a series of tanks which remove about two-thirds of the suspended solids. Scrapers convey the settled solids to six primary digestion tanks. The sludge is retained in the digestion tanks with anaerobic microorganisms for a period of three weeks. Methane and carbon dioxide produced by the sludge digestion are used as fuel for electric power generators. After digestion, the sludge is stored in two open tanks and later dried on an 11-acre drying bed. The dried sludge is used as a fertilizer or land fill.

D305
BEHAVIOR OF WASTEWATER SLUDGES AND CHEMICAL WASTEWATER SLUDGES DURING AEROBIC DIGESTION,

Hamoda, M. F.

Dissertation Abstracts International B, Vol. 38, No. 9, p 4415, 1978.

Aerobic digestion of chemically-treated activated, primary, and precipitated sludges was evaluated in laboratory experiments with alum, ferric chloride, and calcium hydroxide. Doses of 200-600 mg/liter of calcium hydroxide, 8.1-22.3 mg/liter of alum, or 10-30 mg/liter of ferric chloride were added to five types of sludge originating from primary treatment, activated sludge, lime treatment, and mixed liquor treatment with alum or ferric chloride. The primary and activated sludges were employed as the controls in the batch and semi-continuous aerobic digestion systems. Sludges treated in semi-continuous digestors had a higher supernatant quality, dewaterability and oxygen uptake rate. A linear correlation existed between the decomposition rate constant for volatile suspended solids reduction and the initial volatile suspended solids concentration in batch digestion systems. For lime primary sludges, a linear relationship was found between the decomposition constant and alkalinity during digestion. Nitrification decreased in sludges treated with high lime dosages; settling and filtration improved after aerobic digestion for 10-12 days. Soluble phosphorus was released from the lime primary sludge after storage for 15 days at 20 C. Aerobically-digested alum or ferric chloride activated sludge required storage for up to 10-15 days and exhibited poor settling and filtration properties. Control activated sludges were unaffected by aluminum or ferric additions during aerobic digestion and displayed lower oxygen uptake rates than primary sludges.

D306
USE OF A NATURAL MARSH FOR WASTEWATER POLISHING,

Fetter, C. W. Jr., Sloey, W. E., and Spangler, F. L.

Wisconsin University,
Oshkosh,
Department of Geology.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 290-307, February, 1978. 13 fig, 10 tab, 22 ref.

The purification capacity of a marsh receiving agricultural and municipal effluent was evaluated in on-site studies at the Brillion Marsh in Wisconsin. Water samples were collected over a 14 month period at sites above the municipal treatment plant outlet, below the discharge point, and below the Brillion Marsh. During a three day intensive study, the 385 acre marsh received a total inflow of 4,675-6,390 cu m/day; waste water comprised up to 50% of the total inflow during the summer. The effluent substantially increased stream water levels of BOD, COD, orthophosphate, total phosphorus, coliform bacteria, and ammonia. The treatment plant waste water contained 83 mg/liter BOD, 9.07 mg/liter total phosphorus, 200 mg/liter COD, and 3.77 log coliforms/100 ml. Significant amounts of dissolved solids and nitrate were recorded above the effluent outfall; these concentrations decreased below the discharge point. Effluent samples collected after polishing by the marsh revealed that BOD was reduced by 80.1%, COD by 43.7%, coliform bacteria by 86.2%, nitrate by 51.3%, total phosphorus by 13.4%, and orthophosphate by 6.4%. Dissolved solids increased by 16.7%; suspended solids and turbidity decreased by 29.1% and 43.5%, respectively. An estimated mass balance of phosphorus indicated that an annual phosphorus reduction of 32% was achieved by the marsh.

D307

REMOVAL OF POWDERED ACTIVATED CARBON FROM WATER BY FOAM SEPARATION,

Bishop, P. L.

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Durham,
Department of Civil Engineering.

Separation Science and Technology, Vol. 13, No. 1, p 47-57, 1978. 5 fig, 2 tab, 14 ref.

The use of powdered rather than granular activated carbon in water and waste water treatment is limited by available techniques for removing the carbon from the treated suspension for regeneration. Foam separation with a cationic surfactant was evaluated for carbon suspension separation in tests with a continuous reaction. Compressed air was introduced into the base of the 10 cm-diam reactor column at a rate of 0.4-0.8 standard cu ft/min/sq ft. The cationic surfactant, ethylhexadecyldimethylammonium bromide, was added as the foaming agent in doses of 30, 50, and 70 mg/liter. Powdered carbon was completely removed from the effluent with a surfactant dose of 30 mg/liter and a liquid flow rate of 0.3-0.6 gal/min/sq ft. About 1% of the influent load was removed as foam; a 30 mg/liter surfactant dose resulted in an effluent surfactant content of 8.6-12.1 mg/liter. Column design modifications and more efficient aeration were suggested for greater removal of the surfactant from the effluent. Activated carbon regeneration was enhanced by a lower aeration rate and surfactant dosage; effluent quality was improved by higher aeration rates, lower hydraulic loading, and lower surfactant dosages. Foam separation with a surfactant was more efficient in powdered activated carbon removal than air flotation alone.

D308
HOW CHLORINE AFFECTS SOLUBLE COD IN ALGAL LADEN SYSTEMS,

Wight, J. L., Johnson, B. A., Reynolds, J. H., and Middlebrooks, E. J.

Water and Sewage Works, Vol. 125, No. 3, p 48-52, 54, March, 1978. 14 fig, 3 tab, 20 ref.

The impact of chlorination on soluble COD concentrations in waste water containing high levels of algae was analyzed in laboratory tests and in experiments conducted at the Logan City, Illinois, municipal sewage treatment lagoons. When chlorine doses of 4.2, 16.9, and 50.8 mg/liter were added to secondary sewage effluent, free chlorine residuals ranged 0-5.90 mg/liter. In the laboratory studies, soluble COD concentrations in the chlorinated algae-bearing effluent increased from an initial 24.31 mg/liter to a high of 38.73 mg/liter and from an initial 52.70 mg/liter to a high of 70.37 mg/liter after treatment with chlorine at a dose of 50.8 mg/liter. COD concentrations increased substantially during the first 15 min of chlorine contact. Corresponding increases were not observed in field studies of COD concentrations after chlorine disinfection. In field experiments, soluble COD increases in algal laden waste water were apparent only for unfiltered sewage lagoon effluent having a free chlorine residual. Oxidation of organic substances by free chlorine residuals where sand filtration was not employed contributed to the soluble COD increases.

D309
THICKENING OF WASTE ACTIVATED SLUDGE WITH A DISSOLVED AIR FLOTATION UNIT,

Langenegger, O., and Viviers, J. M. P.

Water Pollution Control, Vol. 77, No. 1, p 79-86, 1978. 7 fig, 3 ref.

An air flotation system for concentrating waste activated sludge was designed in relation to the specific properties of activated sludge. Sludge volume index, suspended solids, volatile suspended solids, and sludge age were used as design criteria. Mixed sludge liquor reacted with a pressurized air-water solution was introduced to a clarification tank equipped with scrapers. Four samples of activated sludge from different treatment plants were treated in the air flotation pilot plant. A solids loading rate of 10 kg/sq m/hr required an air-solids ratio of 0.03; a downward flow rate of 6 m/hr in the clarifier reduced suspended solids by 98%. Water levels in the flotation tanks were adjusted to contact the varying float layer with the fixed level scraper. The scraper was operated at a speed of 1 m/min and a depth of 5 mm. Weirs were recommended for full scale plants so that water levels could maintain float layers above the water line and limit the total layer to 600 mm to facilitate drainage. Adequate turbulence in the reactor zone was recommended to promote adhesion of the sludge particles and the air bubbles.

D310
BUTANE IS NEARLY 'IDEAL' FOR DIRECT SLURRY FREEZING,

Randall, C. W.

Water and Wastes Engineering, Vol. 15, No. 3, p 43-44, 47-49, March, 1978. 4 fig, 1 tab.

Direct slurry freezing of waste water sludge with butane as the cooling agent was evaluated with batch and continuous flow reactors. The batch reactor, with a sludge volume of 1.5 liters, had a larger surface area than the 2 liter continuous flow reactor; the larger surface area increased the heat transfer rate, minimizing sludge detention times. The effectiveness of batch treatment was dependent upon the sludge detention time in the reactor and the quality of the filtrates. Higher suspended and dissolved solids concentrations in the sludge required longer detention times in the continuous flow reactor for adequate treatment. A sludge cake solids concentration of 77% was achieved after vacuum filtration and gravity drainage in batch tests, compared to 18% concentration without sludge conditioning and 40% for continuous flow tests. Recovery of 40-60% of the butane after treatment was accomplished with a single compressor. The addition of a second compressor increased butane recovery to 70-80%. The direct slurry freezing process was competitive with other sludge treatment methods at an estimated cost of $6-20/ton dry solids processed.

D311
WHAT TO CONSIDER IN BASKET CENTRIFUGE DESIGN,

Hagstrom, L. G., and Mignone, N. A.

Envirex, Incorporated,
Waukesha, Wisconsin.

Water and Wastes Engineering, Vol. 15, No. 3, p 58, 60, 62, March, 1978. 3 fig, 5 ref.

Parameters involved in the effective design of a bottom feed, continuous batch basket centrifuge for sludge dewatering were examined in studies with sludge samples from five municipal treatment facilities. Basket centrifugation, which removes cavity and capillary water, is used to dewater or thicken feed slurry, skimmings, dewatered cake, and centrate. The slurry to be dewatered during centrifugation is passed into a bowl via a continuous 360 degree slot in the bowl floor. Turbulence and slippage of the sludge in the bowl is reduced by this entrance scheme. Samples of contact stabilized, extended aerated, and activated sludge from the five treatment facilities were dewatered in the basket centrifuge tests. Results indicated that cationic polymer additions enhanced machine throughputs and solids recovery. At constant feed rates and polymer additions, increasing sludge ages decreased the machine throughput and significantly affected solids recovery but not cake concentration.

D312

THE MEMBRANE FILTER PLATE,

Edmondson, B. R., and Brooks, D. R.

Water Services, Vol. 81, No. 975, p 272, 274-278, May, 1977. 3 fig, 6 tab.

A sludge press equipped with membrane filter plates which can be stopped at the optimum point of the cycle is evaluated. Recess and membrane filter plates are mounted alternately within the press to provide flexible and fixed surfaces. At a predetermined sludge level, the press apparatus is stopped and the sludge is squeezed at a pressure of 827 kilopascals for a duration required to produce the desired cake solids content. The dewatering efficiency of the membrane filter plate system was examined in pilot plant tests conducted with sludge which had been conditioned with lime and copper. A comparison of the membrane filter plate and the recess press showed a 37-133% increase in dry solids produced by the membrane filter press at feed times of 150-180 min. Further tests indicated that the press cycle could be reduced to 45 min for sludges that are easily dewatered. The dry solids content of the sludge cake could be controlled by the pressing time. A press converted to the membrane filter plate process could produce an increase in output of up to 50% over conventional press operation; this output could increase by 100% under automated operation.

D313

WASTEWATER PURIFICATION IN BIOLOGICAL TREATMENT PONDS WITH ALGAL GROWTH (Ochistka stochnjikh vod v apbgapizirobannjikh bioprudakh),

Tereshina, A. N.

Vodosnabzhenie i Sanitarnaia Tekhnika, No. 9, p 25-26, 1977. 1 tab, 9 ref.

Experiences with the use of algal ponds in the biological treatment of municipal waste water are presented. The algal ponds have depths in the range of 0.6-0.9 m and are sectioned. They are established on impermeable ground where possible and are sealed with polyethylene foil in permeable regions. They are initially seeded with algae (Cyanophyta, Diatomaea, and Chlorophyta) at a dosage of 300 mg/25 cu m of water. The waste water throughput is generally in the range of 400-1,000 cu m/day at a hydraulic load of 800-1,375 cu m/ha/day and an organic matter load of 106-137 kg/ha/day. After 99.9% of the E. coli are destroyed, the treated waste water is drained off via pipes installed above the bottom. The treatment efficiency and chlorophyll synthesis rates are comparable for algal ponds in the Baltic region and in Central Asia, in spite of the considerable differences in climate and temperature.

D314
DEEP SHAFT SYSTEM USES GRP,

Water and Waste Treatment, Vol. 21, No. 1, p 25, January, 1978.

Corrosion resistant glass-reinforced plastic was employed in the construction of a deep shaft effluent treatment facility where the equipment would be exposed to high chloride concentrations in the industrial effluent treated with municipal wastes at the Marsh Farm Sewage Works in Tilbury, Essex, England. Effluent is aerated as it is passed down through the 132 m downcomer with a 1,200 mm diameter. The downcomer construction required corrosion resistance for an anticipated life span of 30 years. Glass-reinforced plastic tubes, in 10 m lengths, provided the required resistance to the corrosive chloride concentrations and the necessary mechanical strength to hang freely in alignment with the supporting shaft. The plastic sections were joined together by locks and injected with resin, providing durability under high tensile loads. The bell-mounted T piece, through which the effluent enters the downcomer, was also constructed of glass-reinforced plastic.

D315
MINI SEWAGE WORKS,

Water Services, Vol. 81, No. 982, p 760, December, 1977. 1 fig.

A municipal sewage treatment unit, developed by Simon-Hartley of Stoke-on-Trent, England, provides extended aeration for small volumes of municipal effluent. The treatment unit is designed for simple operation in municipal facilities where volumes of sludge produced are limited or in warm climates where sludge is used for irrigation. The compact unit treats fluctuating flows in communities where sewage output may increase several fold at certain periods of the day. The Capitox treatment unit uses initial coarse screening of influent, followed by the mixing of the raw sewage with recirculated sludge before aeration. A Simcar aerator is employed; a weir box passes the liquid effluent into the settling basin containing an inlet stilling box and a weir. Solids are screened before leaving the aeration tank; sludge is removed from the settling tank and returned to the beginning of the treatment cycle for mixing with the influent. Tanks are constructed of either steel or concrete from a variety of components, dependent upon the specific application.

D316

DISINFECTION OF MUNICIPAL WASTE WATER WITH GAMMA RADIATION,

Melmed, L. N.

City Health Department,
Laboratory and Technical Services Branch,
Johannesburg, South Africa.

Water SA, Vol. 2, No. 3, p 131-135, July, 1976. 2 fig, 4 tab, 2 ref.

Disinfection with gamma radiation to reduce E. coli counts to within irrigation or potable water standards was tested with biological filter effluent, maturation pond water, and chlorinated water. Samples of effluent from a two-stage biological filter were treated with cobalt-60 at doses of 10-90 krad and 100-2,000 krad. An E. coli count of less than 1,000/100 ml was achieved for settled biological filter effluent with radiation doses of 50 krad and greater. Retention of the settled effluent in maturation ponds for 26 days without radiation treatment reduced the E. coli count to 200/100 ml, a level comparable to radiation treatment with 100 krad. Irradiation of maturation pond effluent at doses of 10-1,000 krad resulted in no residual E. coli colonies after radiation treatment with 50 krad or more, but unacceptable total residual bacteria counts. A potable water standard was reached after radiation at 200 krad for maturation pond effluent and for settled filter effluent with 2,000 krad. Chlorination of settled filter effluent with 4.3 mg chlorine for 5 min produced a residual E. coli count of 1,000/100 ml. Simultaneous and successive chlorination and radiation with 30 krad resulted in residual E. coli counts of 0.357% and 0.347%, respectively. Radiation followed by chlorination, radiation alone, and chlorination alone produced higher residual E. coli percentages.

D317

SOLVING SLUDGE BULKING PROBLEMS,

Barnard, J. L.

Water Pollution Control. Vol. 77, No. 1, p 103-106, 1978. 1 fig, 2 ref.

The identification and elimination of sludge bulking problems caused by treatment deficiencies or by bacterial population shifts were reviewed. Low dissolved oxygen levels in mixed liquor were conducive to the growth of Sphaerotilus natans, a filamentous bacteria causing bulking. Increasing the oxygen load or adding 5-19 mg/liter of chlorine to the return sludge was effective in inhibiting the growth of filamentous bacteria. Incorporating a nitrification-denitrification phase of operation into the treatment system was also an effective debulking method. Sulfide loads in the effluent feed from septic wastes or pulp mill effluents were reduced by oxidation to sulfates in a biological filter or by aeration without the addition of activated sludge. Nutrient deficiencies in the waste water were alleviated by maintaining a nitrogen:phosphorus:BOD ratio in excess of 5:1:150. Pretreatment of high carbohydrate effluents with anaerobic processes or biological filtration reduced sludge bulking problems. Sludge age up to 60 days, identified as a bulking problem, was rectified by more frequent wasting of sludge under 30 days old. Dairy wastes contributing to shock loads were effectively treated with batch aeration followed by settling. PH variations caused by excessive nitrate formation were controlled by providing an anoxic zone to denitrify the nitrates and increase the pH to a neutral value.

318

VACUUM FILTRATION, WITH PARTICULAR REFERENCE TO OPERATIONAL AND MAINTENANCE PROBLEMS,

Mansfield, R. A.

Water Pollution Control, Vol. 77, No. 1, p 61, 1978.

Problems encountered with the operation and maintenance of a vacuum filter for digested sludge dewatering at the New Germany waste water treatment facility in South Africa were discussed. The sludge, which was buried after treatment, was excessively dewatered, creating an additional 21% solids loading on the digestor. The edges of the polypropylene monofilament filter, with a 1.85 m diameter, were sealed by vulcanizing the rubber edges with heat. Fibers and other materials collected and clogged the pipelines at the check valves, the polyelectrolyte-sludge mixing unit, and the spray nozzles. Sand and grit caused excessive pump water; the dosing pumps in the polyelectrolyte make-up tank were obstructed by insects entering the tank. An overhead gantry was required for repairs; the use of reclaimed effluent required pump, blower, and chlorinator housings.

D319

GAMMA RAY TREATMENT REAPS HARVEST FROM SEWAGE,

Environmental Protection Survey, p 21, February, 1978. 2 fig.

Disinfection by gamma irradiation is promoted for sewage sludge used as fertilizer. Irradiation with cobalt-60 or cesium-137 is conducted in a 7 m-deep shaft with a concrete shield. The radioactive material is enclosed in corrosion resistant steel pipes contained in a closed flushing water circuit; sludge is automatically circulated around the radioactive material. The irradiation process effectively destroys pathogens and parasitic worm ova, as well as seed germination capability. The disinfection process maintains the fertilizer value of the sludge and increases the dewaterability by up to 50%. Gamma radiation does not produce pollutants or utilize oxygen or hydrocarbon fuels. About 12% of the cobalt-60 must be replaced each year; cesium-137 lasts about 10 years, making it slightly less expensive. The packaged disinfection plants are currently available in sludge output capacities of 1-250 cu m/day and 15 cu m/day.

D320

SLUDGE DISPOSAL: THE PROBLEM, THE SEARCH, THE SOLUTION,

Haag, R.

Rickel Manufacturing Corporation,
Kansas City, Missouri.

Public Works, Vol. 109, No. 3, p 58-61, March, 1978.

The sewage sludge land application system used by the Moorhead waste water treatment plant in Minnesota is described. The anaerobic digestion treatment system serves a population of 35,000, producing 30,000 gal/day raw sewage. The plant has a design capacity of 4.5 mgd with a 95% BOD and suspended solids removal efficiency. Two tank trucks with capacities of 3,000 and 3,500 gal were replaced by the high flotation Big A 4500 truck manufactured by Rickel Manufacturing Corp. of Salina, Kansas. The high-flotation truck allowed sludge application to thawing ground which had previously been inaccessible during the spring. The municipality transports 70,000 gal/week of whey and ice cream wash water from a local dairy products manufacturer which financed the high-flotation truck. This arrangement has reduced the treatment plant's BOD load by 1,500-2,000 lbs/day and the dairy's sewerage charges from $77,000 to $36,000. Approximately 3.5 tons of sludge are applied to each acre at a cost of $87.50/acre; the nitrogen and phosphorus pentoxide value of the sludge as fertilizer is approximately $74.20/acre.

D321

TREATMENT AND USE OF SEWAGE PURIFICATION PLANT SLUDGES,

Brekelmans, K., and Hall, H.

J. M. Didier and Associates,
Brussels, Belgium.

Water Services, Vol. 81, No. 975, p 264, 266-268, May, 1977. 1 tab, 7 ref.

Methods of sewage sludge treatment, use, and disposal are evaluated. Various parameters of raw or primary sludge and digested or secondary sludge are reviewed, including: pH, dry residue, fat, protein, carbohydrates, lignins, and ash content. The production of sludge gas at a rate of 0.6 cu m/kg of organic matter by anaerobic fermentation converts the organic matter into methane and carbon dioxide without nitrogen loss. Anaerobic fermentation also reduces the pathogens, parasitic worm ova, grease, and odor and breaks down organic nitrogen and phosphates. Disposal of sludge into the sea, onto the land, or through incineration is reviewed; land application of stabilized, digested sludge has the advantage of providing plant nutrients to the soil. Sludge dewatering techniques with cationic or polyelectrolytic conditioning agents, flotation, and centrifugation are discussed; the need for sterilization of the dewatered sludge before land application is stressed.

D322

THE USE OF FILTERBELT PRESSES FOR DEWATERING OF SEWAGE SLUDGES,

Howell, H. O.

Water Pollution Control, Vol. 77, No. 1, p 66-68, 1978. 2 fig.

Filterbelt presses for sludge dewatering with chemical conditioning, pressurization, and shearing are discussed. Chemically flocculated sludge is fed to the filterbelt press for gravitational dewatering by positive displacement pumps. Pressure is exerted on the dewatered sludge as the filter belts converge; shearing or bending of the sludge further releases water, producing a final 99% solids sludge. New designs in filterbelt presses are based on one or both belts constructed of mesh with a longer shearing stage and reversible roller support cages. The choice of chemical flocculant, diluted to 0.05-0.1%, determines the optimum sludge conditioning for dewatering. The belt speed of the press is linearly related to the filter cake quality; higher pressures result in more extensive moisture removal. Anaerobically digested primary sludges are more easily dewatered and have higher solids contents. Filterbelt presses offer low maintenance costs, capital outlay, and labor costs; a high quality sludge cake is produced within a short operation period. The presses also are compact and provide aerobic conditions to prevent phosphorus release from the sludge.

D323

PROBLEMS ENCOUNTERED IN THE UP-GRADING OF SOME SMALL SEWAGE WORKS,

Abbott, A. L., and Law, I. B.

Water Pollution Control, Vol. 77, No. 1, p 106-111, 1978. 4 fig, 6 tab.

A treatment plant with a design capacity of 5.45 million liters/day employing primary and secondary digestion was redesigned for a potential capacity of 12 million liters/day and upgraded for tertiary treatment. Additional settling basins and tertiary filters were incorporated into the plant; existing settling tanks were converted to humus tanks and secondary filters to tertiary filters. Part of the effluent was stored for industrial use and the rest was used for irrigation. The second treatment plant, employing the activated sludge process, lacked nitrification and had a COD removal rate of 81%. To increase the low dissolved oxygen concentration, a digestor tank was redesigned as an aeration tank and larger aerators were installed. The third plant, treating a combined flow of municipal and cannery wastes, was overloaded by 80-90% during the canning season. Performance testing of the filter yielded a 28% COD removal efficiency and a 36% BOD removal capacity. Secondary filtration was installed to provide 60% COD removal during the canning season. The fourth facility with a design capacity of 3.4 million liters/day had 100% overloading of its filters, humus tanks, and digestor. An oxidation pond was constructed; sand filters were converted to secondary humus tanks; a sludge dewatering tank was installed; and mechanical mixing was replaced with gas mixing. The oxidation pond, originally constructed for use by the two towns served by the facility, was converted to use by one town with a flow of 1.36 million liters/day.

D324
ROTATING DISC SEWAGE TREATMENT SYSTEM,

Godfree, R. E.

Dickson Environmental Engineering Limited,
Guildford, Surrey, England.

Water Services, Vol. 81, No. 982, p 748, December, 1977.

A rotating biological disc with an automatic drum filter allows higher loading rates and eliminates the need for final clarification or settlement of the municipal effluent. The biological disc is constructed of polyvinyl chloride in a continuous spiral configuration which maintains uniform contact of the sewage effluent with the rotating disc. The waste water passes by gravity flow through a filter cloth mounted on a perforated drum. The filtration process requires about 3 min, with longer times allowed for effluent with a high suspended solids content such as activated sludge. The 1.5 m and 2.0 m diameter disc packs have effective capacities of 12 g/sq m and 16 g/sq m BOD load, respectively. Under these loading conditions, the treated effluent has a BOD content of 20 mg/liter and a suspended solids level of 30 mg/liter. Higher removal rates can be achieved by the rotating disc filter with longer contact times; filter performance is dependent upon the texture of the filter cloth. The system can function as a secondary or tertiary treatment method, based upon the filter texture.

D325
DEWATERING OF SLUDGE AT COMPACT SEWAGE TREATMENT WORKS,

Water Services, Vol. 81, No. 982, p 757, December, 1977.

Restricted land area in Copthorne, Sussex, England, mandated the installation of a compact, drum vacuum filter for sludge dewatering rather than drying beds which would have required a 10,000 sq ft area. The treatment system selected to serve the population of 10,000 included initial pretreatment with screening and degritting. The system contained turbine aerators with high rate circulation for activated sludge treatment; provisions were also made for aerobic treatment of sludge. A daily volume of 5,000 gal of sludge with a 98% moisture content was conditioned with lime and ferric chloride and thickened in storage tanks before filtration. The rotating drum vacuum filter with a surface area of 78 ft and a belt discharger, dewatered the sludge to 80% moisture content. Capital and maintenance costs of the system were about equal to those of drying bed sludge treatment systems.

D326

EFFLUENT TREATMENT PLANT FOR THE SMALLER COMMUNITY,

Ward, A.

Robert Hudson (Raletrux) Limited,
Leeds, Yorkshire, England.

Water Services, Vol. 81, No. 982, p 751-752, December, 1977. 3 fig.

Three desludging units, mnaufactured by Robert Hudson Ltd. of Leeds, Yorkshire, England, provide sludge screening and scraping for small waste water flows. The Hudson Bioscreen incorporates a bar screen mounted within a rectangular section channel. The bar screen is angled at 30 degrees to the water surface, effectively increasing the screening area at any channel width. The Rotosludge unit contains a half bridge scraper with adjustable blades in a circular tank. The system is manufactured in standard modules which allow custom, low-cost installation. The rectangular tank Autosludge scraper unit, also built in standard modules, provides savings in capital and installation costs that can be returned within five years. The Autosludge unit, constructed of corrosion resistant materials, is almost entirely submerged during operation.

D327

FILTER SACK DEWATERING,

Water Services, Vol. 81, No. 982, p 757, December, 1977. 1 fig.

A Degremont Laing filter sack sludge dewatering system is capable of high drying performance with a compact and adaptable design. A 1.0 m diameter Trevira polyester fiber sack hangs vertically within a 2.50 m high cylinder. The polyester fiber is resistant to the chemical and physical degradation by waste water. Sludge is first flocculated with a polyelectrolyte in a rotating drum; it is then passed into the polyester filter sack. The unit can accommodate up to six sacks having sludge capacities up to six times the volume of the sack. The filtrate seeps through the sack and is directed onto a sloped plate at the base of the unit. A slide valve at the bottom of the sack, through which sludge is removed, allows for a very dry sludge where required. The retention time of the sludge in the sack determines its final moisture content. A retention time of 30 min produces 29% solids; the solids content is increased 35% and 40% after retention times for 2 and 18 hrs, respectively.

D328

BLOWERS FOR WATER RECLAMATION WORKS,

Water Services, Vol. 81, No. 982, p 752, December, 1977.

Waste water treatment aeration units, manufactured by Hick Hargreaves, a division of Electrical and Industrial Securities Ltd, have been designated for installation in the Loughborough Water Reclamation Works in England. Two 3150 Series 1423 Blowers will be put into operation with a third maintained as a standby. The aerators will have variable capacities ranging 2,000-5,000 cu ft/min at a pressure of 6 lb/sq in-g. Dissolved oxygen concentrations in the four aeration tanks will be monitored by eight probes mounted in banks of four. Each bank is capable of operating the aerators at variable speeds, dependent upon the measured dissolved oxygen levels. The aerators will function automatically when the oxygen level deviates by 0.5 mg/liter from 2.0 mg/liter. Noise levels at speeds between 450-980 rpm will be controlled by acoustic hoods and reactive-absorptive silencers. Electrostatic dry clean precipitors will filter the air.

D329
THE DESIGN AND CONSTRUCTION OF THE MARTHOLME REGIONAL SEWAGE-TREATMENT WORKS,

Roberts, P. D., Chadwick, D., and Richardson, D.

Water Pollution Control, Vol. 76, No. 4, p 493-504, 1977. 4 fig, 3 tab, 1 ref.

The design of the Martholme Regional waste water treatment facility in England, under the jurisdiction of the North West Authority, is described. Waste water from the Calder River valley is pumped to the regional facility; Hyndburn River valley wastes are transported by gravity flow. The plant has a 1991 design dry weather flow capacity of 74,880 cu m and a full flow capacity of 175,300 cu m. The flow to the plant by 2011 is estimated as 101,550 cu m dry weather flow and 237,730 cu m full flow. The raw sewage flow to the regional facility has an average BOD load of 283 mg/liter and a suspended solids content of 162 mg/liter. Treatment at Martholme includes initial screening and degritting, storm water separation, primary sedimentation, aeration, secondary settlement, and activated sludge return. Methods of sludge disposal, such as digestion and land disposal, dewatering and landfill disposal, and incineration, are being considered.

D330
ODOR AND CORROSION CONTROL,

Water Services, Vol. 81, No. 982, p 752-753, December, 1977.

Hydrogen peroxide treatment of odorous and corrosive sulfides produced by anaerobic microbial activity in sewer mains was demonstrated by the Severn-Trent Water Authority in Wimpstone, England. The daily waste water flow averaged 30-40 cu m with a three hr waste retention time in the sewer main during the day, increasing to 7 hrs at night. The sulfide content at the pumping station was 6-20 ppm and up to 10 ppm beyond the pumping station. Hydrogen peroxide was injected into the sewer main by a pump equipped with a storage container. A hydrogen peroxide dose of 180 mg/liter of sewage resulted in adequate oxidation of sulfides. The daily hydrogen peroxide dosage averaged 6 kg; treatment was required only in the summer months. The total cost of the installation was 200 pounds sterling, with a daily chemical cost of 1.50 pounds.

D331
AERATION PLANT FOR SMALL COMMUNITIES,

Water Services, Vol. 81, No. 982, p 753-754, December, 1977.

Aeration plants designed for the treatment of wastes from small populations are manufactured by Satec Ltd. of Cheshire, England. The Satec aeration units for communities with populations up to 600 and up to 2,300 are rectangular structures constructed of steel in factory built form for ease of installation or in small plate form. The aeration plant operates on the extended aeration method of activated sludge treatment. Concrete aeration structures are also manufactured for this size range. The concrete aeration and settlement tanks operate on the diffused air or mechanical aeration technique. Diffused air plants with contact stabilization are manufactured for populations ranging 1150-18,000, using a circular steel tank or a concrete tank with an inner steel tank. For populations of 1,500-25,000, a mechanically aerated rectangular tank with a separate circular settlement tank has been developed for extended aeration.

D332
WASTEWATER TREATMENT PLANT CLEANS UP MASSACHUSETTS RIVER,

Water and Sewage Works, Vol. 125, No. 3, p 75, March, 1978.

A municipal waste water treatment plant with a 52 mgd capacity was constructed to reduce the pollutant load on the Merrimack River in Massachusetts. The activated sludge treatment plant, designed by Camp, Dresser, and McKee, Inc. of Boston, serves the municipalities of Lawrence, Andover, North Andover, and Methuen. Influent is pumped through a 2,800 ft long force main to the plant where it undergoes primary sedimentation and aeration. The effluent is then treated with secondary sedimentation and is chlorinated before discharge into the Merrimack River. Sludge produced during treatment is dewatered and incinerated; stack gases are scrubbed before emission into the atmosphere. The treatment plant is equipped with 8 heavy duty sluice gates, 40 aluminum slide gates, and 9 roller gates. Six of the 8 sluice gates are electrically operated. Two interceptor sewer lines, one 21,600 ft long and the other 9,400 ft long, collect the municipal wastes for transport to the facility. Flowmeters measure the input from each community for calculation of operating expenses.

D333

WASTEWATER SYSTEM PROVIDES NEW WATER SOURCE FOR ST. PETERSBURG,

Water and Sewage Works, Vol. 125, No. 3, p 18, 26, March, 1978.

A water metering system installed in St. Petersburg, Florida, distinguishes between the potable water lines and the secondary effluent lines used for irrigation water. Because of a lower than average rainfall in the Tampa Bay area, treated effluent containing nutrients was directed to a sprinkler system for municipal and private irrigation. Approximately 10,000 meters will be installed at the distribution points to monitor the water application rates and to curtail runoff. A combined color and manufacturer coding system was selected to distinguish the secondary effluent system from the more than 90,000 water meters in the area. A blue plastic meter, produced by Kent Meter Sales, Inc, was selected over its bronze counterpart. The plastic meter is corrosion resistant, does not form metal oxides, and costs $10 less than bronze meters. Installation of the plastic meter is expected to reduce the meter discard rate from 6,000/yr to 1,000/yr during upgrading of the system.

D334

OPERATIONAL EXPERIENCE AT THE BORCHERDS QUARRY WASTEWATER TREATMENT WORKS,

King, P. B.

Water Pollution Control, Vol. 77, No. 1, p 111-112, 1978.

The operation of a waste water treatment facility with a population capacity of 55,000 was discussed. The treatment included screening, degritting, and metering of the influent before transport via a sump to a 5,580 cu m aeration tank. Liquid separated from the sludge in a settling tank was passed through three maturation ponds before discharge into a river. The initial capacity of the plant was 3,750 cu m/day with an average flow less than 7% of the design flow. The flow was increased to 425 cu m/day by diversion of conservancy water to the plant and by discharge of domestic wastes to the plant four days a week to increase the organic load. With the additional discharges, the population equivalent was increased to 34,500, based on a 110 g COD/day concentration. Influent samples on days when domestic sewage was discharged to the plant contained 50,000 mg/liter COD and 2,500 mg/liter ammonia nitrate. Maturation of the treated effluent in lagoons for 60 days reduced the COD concentration to 150 mg/liter and ammonia nitrate levels to 1 mg/liter. Upgrading of the plant to a population capacity of 55,000 was accomplished by the addition of two aerators, a settling tank, and a screw pump. Two screens were added in the grit channel to supplement a hand-raked bypass screen that was subject to clogging. Activated sludge was returned to the sewage sump to reduce pump blockage, eliminate odors, increase denitrification, and maintain sludge return during power failures.

D335

OZONE IN THE TREATMENT OF ODORS FROM SEWAGE WORKS,

Elphick, A., and Favell, G. E.

Water Services, Vol. 81, No. 975, p 280-282, May, 1977. 1 fig.

Ozone deodorization of municipal wastes was compared to chemical spraying and activated carbon methods of treating sewage odors. The substances primarily responsible for malodorous emissions from sewage are skatole, indole, hydrogen sulfide, and mercaptans. Chemical spraying of the wastes masks the sewage odor with an aromatic odor. Activated carbon adsorbs odorous skatole and mercaptans more readily than hydrogen sulfide. Replacement or regeneration of the activated carbon is required about five times a year. About 860 lbs of activated carbon at a cost of 900 pounds sterling are necessary for carbon adsorption of odorous substances. Wet well ozonation contacts the odorous substances for 7-10 min before discharge into the atmosphere. Continuous operation of the deodorization process reduces the extraction rate and thus the ozone dose. A retention chamber, providing 20-30 seconds contact time, decreases the ozone injection to about 1.0 ppm. Operating costs for ozone deodorization total about 490 pounds sterling, primarily for the ozone generator's power supply.

D336

THE DANGERS OF INADEQUATE CHLORINATION OF POLLUTED WATERS,

Nupen, E. M., and Morgan, W. S. G.

Water Pollution Control, Vol. 77, No. 1, p 45-50, 1978. 2 tab, 46 ref.

The potentially harmful effects of residual chlorine compounds after chlorine disinfection are reviewed. Hypochlorous and hydrochloric acids, formed when chlorine is added to water, oxidize with nitrogen in the presence of sewage reducing agents to chloramines and free chlorine. Monochloramines must be oxidized to convert ammonia to free nitrogen and to allow dissociation of hypochlorous acid for disinfection. Although E. coli may be eliminated before the breakpoint, or ammonia conversion, viruses and parasite eggs are removed after breakpoint. Chlorine also combines with other organic substances to form toxic chlorinated compounds, such as chlorophenols and potassium sulfocyanide. Tests with some of these compounds indicate that fish egg hatching was retarded by concentrations of 4-chlororescorcinol and 5-chlorouracil as low as 0.001 mg/100 ml of water. Limits established by the United States Environmental Protection Agency allow the discharge of 0.003 mg/liter of residual chlorine, with concentrated residual chlorine discharges containing up to 0.05 mg/liter permitted for 30 min within a 24 hr period. In addition to its toxicity to some fish, chlorine has also been shown to eliminate beneficial heterotrophic organisms while pathogenic organisms remained unaffected.

D337

CROSS-FLOW FILTRATION IN PHYSICAL-CHEMICAL TREATMENT OF MUNICIPAL SEWAGE EFFLUENTS,

Mahlman, H. A., Sisson, W. G., Kraus, K. A., and Johnson, J. S., Jr.

Oak Ridge National Laboratory,
Tennessee.

1976. 126 p, 54 fig, 11 tab, 38 ref. Technical Report EPA-600/2-76-025.

Cross-flow filtration was evaluated for the physical-chemical treatment of primary effluent and activated sludge effluent by conditioning with iron or aluminum salts, or powdered activated carbon as reagents. The cross-flow filtration process involves passing of the effluent flow parallel to a filter surface composed of fire hose jacket fabric to delay the accumulation of flux-limiting filter cake and to separate the influent into filtrate and a concentrated solids slurry. Addition of iron or aluminum salt to primary effluent resulted in a filtrate with 10-15 mg/liter total organic carbon (TOC), <1 mg/liter total phosphate, and a turbidity of <1 Jackson Turbidity Unit. Cross flow velocities of 4.6 m/sec produced average fluxes of 6 m/day with metallic salt treatment; neutralization was necessary before metallic salt addition to prevent contamination of the filtrate. Powdered activated carbon treatment of the primary effluent yielded a filtrate quality similar to that produced by metallic salt treatment but with a lower TOC of 5 mg/liter. Treatment of activated sludge effluent with aluminum salt, iron salt, powdered activated carbon, added separately or in combination, resulted in a higher turbidity, phosphate content, and bacterial population than for primary effluent. Ferric chemical and cross-filtration treatment of primary effluent flows to a plant at 3,800 cu m/day was estimated to cost $.12/cu m. Further research is suggested on various treatment chemicals, the effects of low circulation velocities, and cross-flow filtration of industrial wastes.

D338

MOTORISATION OF PENSTOCKS AT SEWAGE WORKS,

Pipes and Pipelines International, Vol. 22, No. 6, p 28, December, 1977.

Syncropak 16A actuators, manufactured by Rotork Controls Ltd. of Bath, Avon, England, were installed in the Beckton Sewage treatment plant in North London to convert the 8 penstocks on the aerated lagoons from manual to motorized control. The mechanization of the penstocks reduced the operating time from 40 to 6 min. The actuator design was modified to retain control on the outside wall of the aeration tanks and avoid accidents. A bracket was designed to permit tank wall mounting of the actuators. The original penstock stem and position indicator were incorporated into the design and installation of the mechanical control devices. Flow balancing to the 8 aeration tanks led to the installation of motor control. Provisions have been made for future remote control of the actuators.

D339
SULPHIDE ODOURS FROM SLUDGE TREATMENT,

Water Services, Vol. 81, No. 975, p 289, May, 1977.

The use of hydrogen peroxide to oxidize odorous sulfide compounds formed during sludge dewatering has been initiated by Interox Chemicals Ltd. of Widnes, Cheshire, England. Hydrogen peroxide reduced high sulfide levels in return liquor from sludge coagulation and dewatering, removed sedimentation tank odors, and prevented potential septicity. Hydrogen peroxide treatment of sludge prior to dewatering oxidized the sulfides and prevented hydrogen sulfide gas formation during vacuum drying. Hydrogen peroxide dosing of sludge at tanker collection points eliminated sulfide emissions during transport of the sludge to a disposal point. Complications caused by sulfides in primary sedimentation and secondary biological treatment recycled liquors were alleviated.

D340
SOLIDS DEWATERING,

Water Services, Vol. 81, No. 975, p 289, May, 1977.

A mobile sludge dewatering belt filter press, developed by Whitehead and Poole of England, has produced adequate dry solids contents in pilot tests performed at the Newthorpe works of the English Severn-Trent Water Authority. The mobile pilot plant has a design capacity of 8.25 cu m/hr mixed primary and humus sludge. The belt filter press effectively dewatered a sludge flow of 10-13 cu m/hr to a final dry solids content within standard limits. The mobile unit was in operation in waste water treatment plants, water purification plants, and industrial waste facilities over a 12-month testing period. The belt filter press was effective in industrial liquid-solid separation tests and was capable of efficiently dewatering combined domestic and paper mill waste streams. Further tests will be conducted to examine the feasibility of dewatering other mixed waste sludges.

D341
A MULTI-STAGE FILTER BELT PRESS,

Water Services, Vol. 81, No. 975, p 282, May, 1977. 1 fig.

A four-stage filter belt press process for sludge dewatering, manufactured by Ames Crosta Babcock Ltd. of Heywood, Lancshire, England, is constructed of modular units, permitting design customizing for various sludge types. The first stage of the dewatering system utilizes a series of gravity dewatering pockets arranged in a long or short configuration. The second stage presses the sludge between two belts arranged as a wedge. Further pressure is applied in the third stage; the sludge is pressed between belts which are passed over and under a series of drums or rollers. Continuous pressure is exerted on the sludge in the fourth stage by spring loaded plates. The dewatering system, available with belt widths of 1.0, 2.0, or 3.0 m, is designed for continuous operation. Dry solids contents of mixed primary and humus sludges have been increased from 4% to 35% by the filter belt system.

D342
THE THICKENING AND CENTRIFUGING OF SLUDGE,

Howarth, C. M.

Water Pollution Control, Vol. 77, No. 1, p 64-65, 1978.

Methods to improve sludge dewatering and thickening by centrifugation are presented. Investigations were conducted at a treatment plant where a combined municipal and industrial influent was thickened, centrifuged to 25-30% solids content, and incinerated in a fluidized sand bed. Centrifuge performance was upgraded by providing a second thickener; a thick sludge was consistently produced, reducing fuel consumption in the incinerator. Pump wear was reduced by installing a large Mono pump operated at lower speeds. The Mono pump was custom-designed with a spring-operated diaphragm valve for pressure relief during restricted sludge output. Disintegrator pumps, through which the sludge was passed from the thickening tanks to a manifold, were replaced by hand raking operations. Uneven flows to the four centrifuge pumps were eliminated by installing two header tanks equipped with diaphragm valves. Centrate backup into the centrifuges was alleviated by collecting centrate in a sump from which it was pumped to the disposal pipes. Cake dryness increased with greater flow rates; solids recovery decreased with the decrease in liquid retention. Because of its higher oil content, centrate had a 20% higher energy value than the feed sludge or the sludge cake.

D343
HEAT TREATMENT AND PRESSING OF DIGESTED SLUDGE,

Everitt, I.

Water Pollution Control, Vol. 77, No. 1, p 62-63, 1978.

Solutions to problems encountered in two waste water treatment plants in South Africa were presented. Sludge treatment processes at both plants included digestion, heat treatment, decanting, and pressing; an additional sludge thickening stage was present at one plant. Ram pumps at both treatment sites developed cracked cylinders; outlet valves became worn and cracked. Replacement of the ram pumps with Mono pumps was only satisfactory; rotors and stators were abraded by grit. Replacement of the outfall valves with flat valves proved successful. Clogging and bursting of the inner tubes removing treated sludge from the heat exchangers were alleviated by regular washing with a high-pressure water jet and replacement of coil seals with Teflon-wrapped copper seals. Level probes in the pressure vessels required cleaning; the stainless steel discharge valves were replaced with more wear-resistant hardened tool steel and tungsten carbide. The nine presses, each with 55 cast iron plates, developed cracked plates within four years. The cast iron plates in the presses, operating at 65 kilopascals, were replaced with polypropylene plates. Odor from the decant tanks was abated by covering the tanks with floating plastic balls. Decantrates and filtrates with permanganate values of 2,000 mg/liter were introduced into the activated sludge units for clarification.

D344
SEWAGE DEWATERING PLANT FOR SMALL COMMUNITIES,

Water Services, Vol. 81, No. 982, p 747, December, 1977.

Four sewage treatment and sludge dewatering plants are manufactured by Hawker Siddeley Water Engineering for population sizes ranging 75-20,000. Five concrete extended aeration plants are available for populations of 250-1,000. The units, which lower the BOD and suspended solids content of the waste water, require sewage pretreatment with maceration or comminution and follow aeration with sedimentation and pebble bed clarification. The plant for treatment of waste water from a population of 75-500 is constructed of steel; extended aeration and sedimentation with pretreatment of the effluent are used. The concrete plant serving a population of 2,000-20,000 provides a variety of alternative treatment processes of modular design, such as aerobic digestion, clarification, polishing, and sludge dewatering. The compact steel unit for 2,000-20,000 employs degritting, pre-aeration, plug flow aeration, secondary sedimentation, and aerobic digestion in circular concentric tanks. The treatment plant lowers BOD and suspended solids levels to within quality standards. Potable water plants for populations of 300-7,000 are also available.

D345
MODULAR TREATMENT PLANT,

Water Services, Vol. 81, No. 982, p 758, December, 1977.

Modular waste water treatment plants are being manufactured by Albion of Swansea, England, to treat waste water flows from a single family dwelling to a population of 400. The modular components of the system are constructed of precast concrete. The component systems for a population of 4-141 include septic tanks, filters, pump wells, and soakaway and precast cesspools. A modular component system was installed in Talley, Dyfed, England, in a short period of time, despite adverse land conditions. The treatment system includes upflow settlement tanks, storm water tanks, a balancing tank, pump wells, a siphon chamber, humus tanks, and a wall unit filter. Albion is currently developing modular aeration plants to replace filters in restricted sites.

D346
SEWAGE SLUDGE LIME DOSING AND FILTER PRESS FEEDING,

Water Services, Vol. 81, No. 975, p 289-290, May, 1977.

A mixing, pressing, and pumping system was developed by Mono Pumps Ltd. of London, England, for lime dosing during the sludge dewatering. The Mono system eliminates the need for a water source, a mixing tank, a mixer and transfer pump, and pressure maintenance during periods when the pump is idle. The Mono pump, equipped with a cylindrical Monomix unit, draws sewage sludge from the conditioning tank into the chamber while creating a whirlpool action. Proper doses of dry lime are injected by the Monomix into the center of the vortex; adequate mixing is ensured by the pump element. The lime-bearing sludge is returned to the conditioning tank for copperas solution treatment before passing to the filter press for dewatering. The need for pressure vessels is eliminated by the variable speed drive of the Mono Presspack's pump. Constant torque, corresponding to the potentiometrically controlled press pressure, is supplied by the electrically controlled pump. Pressure is maintained within 5 lb/sq in of the required value, producing a uniform filter cake. The unidirectional sludge flow eliminates the need for maintenance of non-return valves.

D347
SEWAGE TREATMENT ROTARY DISTRIBUTOR RANGE EXTENDED,

Surveyor, Vol. 4447, No. 151, p 28, March, 1978.

Rotary distributors, developed by Treatment Plant Contracts Ltd. of Andover, England, are being manufactured in a diameter range of 16-40 ft. The distributors are constructed of corrosion-resistant polyvinyl chloride and fiberglass-reinforced resin; they include a center underfeed unit, a center overfeed unit, and a taper unit. The overfed version requires support beams for diameters of 25 ft or more. A four inch column has replaced the three inch column in the 40 ft underfed siphon unit. The overfed, underfed, and taper units are manufactured in lengths of 5 or 7 ft and can accommodate the entire range of diameters. The 40 ft distributor has a capacity of 40 gal/day and is designed to treat wastes from a population of 500.

D348
SEWAGE TREATMENT EQUIPMENT FOR SINGLE HOUSEHOLDS TO 5000 PE,

Water Services, Vol. 81, No. 982, p 746-747, December, 1977.

Municipal or domestic waste water treatment equipment is manufactured for populations up to 5,000 by Klargester Environmental Engineering Ltd. A three-stage settlement tank is constructed of fiberglass-reinforced plastic for ease of handling and installation. Biological filters with pumps or gravity feed distributors are available for use in areas where effluent disposal is hindered by subsoil conditions. Rotary disc-filters are produced as an alternative to biological filters. An unassembled septic tank provides a compact design, reduced handling and shipping charges, and simple assembly. An unassembled version of the three-stage settlement tank is also available. The fiberglass-reinforced plastic BioDisc unit is suitable for use in climates ranging from desert to subarctic.

D349
BELT PRESS SLUDGE DEWATERING MACHINES,

Water Services, Vol. 81, No. 975, p 290, 292, May, 1977. 3 fig, 1 tab.

Two belt press sludge dewatering systems, developed by the English manufacturer Simon-Hartley, have capacities ranging 2-23 cu m/hr. The three-stage Winklepress dewaters sludge after polyelectrolytic treatment. Consolidation and further dewatering are then performed in a vertical zone with a diminishing width; a final sheer action is applied by bands passing over and under rollers positioned at varying heights. The Winklepress has an input width of up to 2,300 mm with a sewage sludge capacity up to 23 cu m/hr; it produces a combustible filter cake with 35% dry solids. The Simon-Hartley Type HF band press employs the same band and roller configuration as the Winklepress but eliminates the vertical dewatering and consolidation zone. The bands are sprayed before and after they pass over 15 rollers mounted in a continuous horizontal feed position. The band press is available in input widths ranging 200-1800 mm for sewage sludge capacities of 2-18 cu m/hr.

D350
POLISH/U.S. SYMPOSIUM ON WASTEWATER TREATMENT AND SLUDGE DISPOSAL: VOLUME II,

1976. 167 p, 53 fig, 49 tab, 60 ref. Technical Report EPA-600/9-76-021.

The proceedings of the Polish/U.S. symposium on wastewater treatment and sludge disposal, held in Cincinnati, Ohio, on February 10-12, 1976, contain 15 discussions on municipal and industrial waste water treatment practices and water conservation alternatives. Specific topics include: sludge treatment and disposal; treatment of steel processing, coke plant, tannery, and textile wastes; biodegradability assessments; and toxicity analyses of organic compounds. The symposium focuses on studies that were undertaken for seven water projects conducted in Poland on: the treatment of industrial wastes; biological, physical, and chemical waste water treatment techniques; sludge use; and waste water reuse. The Polish delegation represented the Ministry of Administration, the Institute for Economy and Water Management, the Institute of Environment Protection Engineering, the Environmental Pollution Abatement Center, and the Institute of Municipal Economy. The United States delegation was composed of Environmental Protection Agency representatives and members of Carnegie-Mellon University, Clemson University, and the University of Cincinnati.

D351
THE RESEARCH WORKS ON SEWAGE TREATMENT IN POLAND,

Nawara, S.

The Ministry of Administration,
Local Economy and Environment Protection,
Warsaw, Poland.

In: Polish/U.S. Symposium on Wastewater Treatment and Sludge Disposal: Volume II, February 10-12, 1976. 1976, p 2-10. Technical Report EPA-600/9-76-021.

Sewage treatment research, management, and legislation in Poland are discussed. Surface water pollution in Poland results from industrial and municipal operations lacking adequate treatment facilities for chemical, food, and wood processing wastes. Industrial plants are responsible for about 80% of all wastes generated; about 60% of the total waste water volume receives some form of treatment. Technologies have been developed for biological and physicochemical treatment of phenol-bearing waste water; biological treatment of cellulose sulfate wastes; salinated mine water treatment by thermic and hydrothermic methods; storage and treatment of dairy wastes in biological lagoons; and the elimination of hydrogen sulfide from sulfur mine wastes. Future water quality improvement research areas include pilot plant programs, water use optimization, production of biodegradable domestic and industrial materials, data collection systems, and further development of sewage and industrial waste treatment plants. Operations at the biological waste water treatment plant in Czestochowa, Poland, treating a combined municipal and industrial waste water flow, are reviewed.

D352
MARINE WASTE DISPOSAL IN THE NEW YORK BIGHT--PUBLIC POLICY, ENVIRONMENTAL IMPACTS, AND ALTERNATIVE FUTURES,

Italiano, M. L.

National Association of Regional Councils,
Washington, District of Columbia.

1976. 288 p, 6 fig, 10 tab, 156 ref, 4 append. NTIS Technical Report PB-255-222.

The environmental impact of municipal waste and sewage sludge disposal by barge transport to the 2,500 sq mile coastal area off New York City, New York, is evaluated. Barge disposal of dredged materials has been conducted since 1888; municipal waste dumping is now allowed by permits issued by the Environmental Protection Agency. Sediments in the sludge and dredge disposal sites contain increased levels of heavy metals, organic materials, and petrochemicals; both the sediments and the water in the disposal area have elevated coliform bacteria counts. Dissolved oxygen concentrations have decreased and turbidity has increased; benthic organisms are significantly different at the disposal site than in the surrounding area. An alternative to disposal of municipal wastes and dredged materials in the coastal apex area is land disposal of digested sludge. Diked disposal or incineration of dewatered sludge are also considered.

D353

TREATMENT OF COMBINED SEWER OVERFLOWS BY HIGH GRADIENT MAGNETIC SEPARATION,

Allen, D. M., Sargent, R. L., and Oberteuffer, J. A.

Sala Magnetics, Incorporated,
Cambridge, Massachusetts.

1977. 126 p, 24 fig, 21 tab, 15 ref, 6 append. Technical Report EPA-600/2-77-015.

A high gradient magnetic separation technique was applied to combined sewer overflow (CSO) and raw sewage in laboratory and pilot plant tests. Parameters which significantly influenced the separation process were alum concentration, pH, polyelectrolyte dose, and magnetic seed concentration. The magnetic separation of CSO effluent removed 95% of the suspended solids, 99% of the coliform bacteria, and 92% of the BOD. Reductions of pollutants in the raw sewage were 91% suspended solids and 99% coliform bacteria. Optimization of the parameters controlling the magnetic separation process in CSO reduced suspended solids by 98.7%, BOD by 92%, fecal bacteria by 99.85%, turbidity by 96%, and the color by 92%. A 3 min retention of the CSO and the sewage was adequate for the flocculation-seeding process and the magnetic separation. The estimated capital outlay for the process was $107,000/mgd with a maintenance cost of $.137/1000 gal, 40% and 20% lower, respectively, than the costs of other physical-chemical treatment processes compared.

D354

INDEPENDENT PHYSICAL-CHEMICAL TREATMENT OF RAW SEWAGE,

Directo, L. S., Chen, C-L., and Miele, R. P.

Los Angeles County Sanitation Districts,
Whittier, California.

1977. 119 p, 37 fig, 21 tab, 15 ref. Technical Report EPA-600/2-77-137.

Independent physical-chemical treatment of raw sewage with alum and polymer clarification and activated carbon filtration and adsorption was studied at a 50 gpm pilot plant in Pomona, California. The independent physical-chemical process was evaluated as an alternative to biological treatment of raw sewage. The effluent was initially clarified with 25 mg alum/liter and 0.3 mg anionic polymer/liter. Activated carbon adsorption was conducted in a column with a hydraulic loading of 4 gpm/sq ft and a contact time of 30 min. The process reduced COD by 94%, suspended solids by 96.6%, and total phosphate by 92%. Additions of 5.4 mg sodium nitrate/liter N to the carbon column were preferred over chlorination and oxygenation to prevent sulfide generation in the activated carbon. Nitrate additions enhanced biologic activity and allowed high organic loading of the column, removing 3.54 kg total COD/kg carbon and 1.54 kg dissolved COD/kg carbon. Metals removed from the waste water by activated carbon were evident in dust produced during thermal regeneration of the carbon, including: Ca, Cd, Cu, Cr, Al, Fe, Sn, Pb, Ni, and Zn. The estimated cost for a 10 mgd independent physical-chemical treatment, including initial clarification and carbon regeneration, was $0.0869/sq m of effluent.

D355

OPERATING ACTIVATED-SLUDGE PLANTS TO EFFECT NUTRIENT REMOVAL,

Nicholls, H. A.

Water Pollution Control, Vol. 77, No. 1, p 99-101, 1978.

Non-chemical methods to remove nitrogen and phosphorus from waste water during activated sludge treatment were presented. Nitrification occurred in an activated sludge operation at a retention time of 13 days and a dissolved oxygen content of 0.5-1.0 mg/liter. Nitrate removal was effected by establishing an anaerobic denitrification zone near the inlet of the treatment process where oxygen demand was the highest. Raw sewage provided electron donors to the nitrates by installing a plug flow or semi-plug flow system at the treatment plant inlet to facilitate denitrification. Recycling of the nitrate-bearing mixed liquor suspended solids to the denitrification zone, in conjunction with the two previous steps, yielded a 90% nitrogen removal. Phosphorus removal was achieved by mixing influent and sludge from the clarifier in the absence of oxygen and nitrate. Phosphorus ions released into solution under anaerobic conditions were more readily readsorbed onto the sludge with aeration. Before the clarification step, the dissolved oxygen concentration of the mixed liquor suspended solids was maintained at 3.0-4.0 mg/liter to prevent the dissolution of the phosphorus ions. Disadvantages of nutrient removal in a single basin were discussed.

D356

INDUSTRIAL SLUDGE AND ANIMAL SLURRY DE-WATERING,

Water and Waste Treatment, Vol. 20, No. 9, p 30, September, 1977.

A patented device for dewatering sludge and separating liquid and solid wastes has been manufactured by Farrow Irrigation of England. The separator employs stationary screens, roll presses, and brushes. The two processing screens are constructed of stainless steel mesh and are supported by steel aperture plates. The rollers, covered in heavy rubber, and the polypropylene brushes are adjustible for increased compression of solids or wear uptake. The device has two speeds, a speed reduction mechanism, and is powered by a 1 hp electric motor. The separator has a treatment capacity of 5000 gph. Solids can be stored for composting after processing and liquids may be pumped to storage tanks with less probability of souring.

D357

HYACINTHS FOR WASTEWATER TREATMENT,

Joseph, J.

Reeves Journal, Vol. 56, No. 2, p 34-36, February, 1978.

Secondary treatment of waste water with water hyacinths produced significant reductions in impurities, coliforms, and heavy metals in pilot plant tests conducted by the National Space Technology Laboratory at Orange Grove, Mississippi. Biologically treated waste water from a population of 5,000 was introduced into an 0.7-acre hyacinth lagoon which was four to five times smaller than the primary aerated lagoon. Retention times of 14-21 days in the lagoon reduced suspended solids by an average of 72%, total nitrogen by 60%, total phosphorus by 26%, BOD to below standard levels, and coliforms from 121,000 to 40,000/100 ml. In the absence of toxins or metals, the harvested hyacinths yielded up to 25% crude protein for supplemental animal feed. An acre of hyacinths, producing from 8-16 tons wet bio-mass/day, generated 3,200-6,450 cu ft of methane gas/day with 0.5 ton fertilizer as a by-product. The water hyacinths were effective in removing lead, mercury, cadmium, cobalt, nickel, silver, and phenols. Research is being conducted to expand the hyacinth belt north of 33 degrees latitude.

D358

BUCKLAND POLLUTION CONTROL CENTRE IMPROVES ENVIRONMENT IN THE SOUTH WEST,

French, V. H.

Water Services, Vol. 81, No. 975, p 285-286, May, 1977.

The Buckland sewage treatment plant, operated by England's South West Water Authority, is described. The treatment facililty is designed for a population of 50,000 with provisions for expansion to a capacity of 100,000. The influent is screened before flowing into three settling basins equipped with half-bridge rotating scrapers for sludge removal. The waste water is then distributed to two three-sectioned aeration tanks equipped with 8 surface aerators and dissolved oxygen probes. The aerated effluent is passed into three secondary settling basins with rotating scrapers which remove activated sludge for return to the aeration tanks. Sludge is thickened, macerated, and conditioned with lime and copperas before it is pressed and stored. A multi-hearth incinerator with a 2.5 ton/hr capacity operates 50 days a year for sludge disposal. Stack gases are treated in a multi-cyclone unit before discharge.

D359
RECENT ADVANCES IN OZONE TECHNOLOGY,

Rice, R. G.

Water Pollution Control, Vol. 77, No. 1, p 51-55, 1978. 1 tab.

Ozonation has been used for the disinfection of sewage effluent, as well as tertiary treatment, dissolved organics removal, suspended solids reduction, and industrial waste water treatment. Ozonation has replaced chlorination in three small treatment plants in the United States and its use is planned in a number of other plants. Pilot plant investigations of disinfectants, including ozone, ultraviolet radiation, bromine chloride, and chlorine have demonstrated that ozonated waste water is less toxic than chlorinated effluent. Substantial BOD and COD level reductions have been realized with high-level ozonation. Ozone has not been as effective as chlorine in reducing dissolved organic materials in activated sludge effluent. In a California treatment plant, the need for chemical treatment of secondary effluent has been eliminated by pre-ozonation to remove suspended solids. The 10 mg/liter ozone treatment was 10% cheaper than chlorination but did not sufficiently remove coliform populations. Ozone has been found effective in removing colors, tastes, odors, cyanides, phenols, and iron ferricyanide from industrial waste waters. Methods of ozone generation and application, and ozonation of potable water were also reviewed.

D360
BIOLOGICAL WASTEWATER SYSTEM,

Chemical Engineering, Vol. 85, No. 2, p 96, January, 1978.

Ecolotrol Inc. of Bethpage, New York, manufactures the Hy-Flo fluidized bed system for biological waste water treatment. The system utilizes a compact reactor containing a high biomass concentration for carbonaceous BOD removal, nitrification, and denitrification. The high-rate system eliminates the need for large concrete tanks or basins. During operation, waste water entering the bottom of the reactor at a rate of 10-25 gpm/sq ft is contacted with more than 1,000 sq ft of biological growth/cu ft of reactor volume, 20-40 times that which would be expected from other commercially available systems.

D361
WASTEWATER TREATMENT SYSTEM,

Chemical Engineering, Vol. 85, No. 2, p 95, January, 1978.

The Clevepak Corp. of Fall River, Massachusetts, has begun marketing a submerged aeration system for the secondary treatment of waste water. The Aerocleve system provides air bubbles in a size range of 0.2-0.4 mm, increasing efficiency over conventional diffused air devices and mechanical aerators which produce bubbles in the range of 1.0-2.5 mm. Waves which trap pockets of air and strike the walls of the chamber are created by differences in air and waste water velocities in the Aerocleve's mixing chambers. Fine air bubbles are released when the air pockets impinge against the wall of the chamber. An oxygen transfer efficiency of 4.0-6.0 lb 02/brake hp-hr is reported for the Aerocleve system.

D362

A PILOT PLANT STUDY ON ADVANCED TREATMENT OF TREATED SEWAGE FOR RE-USE,

Ando, A., Yamada, T., Kimura, H., and Tamai, Y.

Journal of Japan Water Works Association, No. 518, p 41-61, November, 1977.
19 fig, 13 tab, 5 ref.

Pilot studies were conducted in Osaka, Japan, to evaluate advanced techniques of municipal waste water treatment for reuse as potable water. Water supplies for Osaka and several other districts are obtained from the Yodo River. Due to an increasing water demand by these cities, alternative industrial water supplies, such as treated sewage, are being considered. A three-year pilot plant study has investigated the treatment of municipal waste water by bubble separation, coagulation-sedimentation, activated carbon, rapid filtration, and biological oxidation. Operating experiences and the results of the study are presented.

D363

CIRIA STREAMLINES TANK DESIGN,

New Civil Engineer, p 7, January 5, 1978.

The standardization of sedimentation tank designs in England has been proposed by the Construction Industry Research and Information Association. A report on preferred sedimentation tank designs lists specifications for diameters, depths, and floor slopes for circular and rectangular tanks. For circular tanks serving populations of 3,000-250,000, diameters ranging in size from 8-30 m are preferred. In large diameter tanks with a 2 m/hr surface loading rate, a 2.5 m diameter increase is required for a 7,000 population increase. Preferred sidewall depths for tanks are 2, 2.4, and 3 m, with depths of 4 m in the higher diameter ranges. Four floor slopes are offered: 1/2 1/5, 1/10, and 1/500. More gradual slopes are allowed when shutters are not required. Reports on standardizing biological treatment and sludge treatment plants are being formulated.

D364
SEWAGE SYSTEM REJUVENATION,

Western Construction, Vol. 53, No. 4, p 16, April, 1978.

Inland Steel Company's Blac-Klad Laminated Culvert Stock was used for all conveyance structures used in the upgrading of the Glendive, Montana, sewage treatment plant. Treatment included primary skimming and biological treatment in open lagoons aerated with open baffled flumes. The inlet culvert, the access manholes, and the aerating open flume were constructed of the Blac-Klad culvert stock. Corrugated .064 gauge steel sheets were rolled into culverts ranging in size from 18-60 inches. Exposed areas, especially riveting or welding, were coated with an asphalt base primer. The steel sheets were constructed of 2-oz galvanized copper-bearing culvert steel capable of withstanding the effects of the corrosive waste water. Blac-Klad culvert stock pipe is also manufactured in 12, 14, 16, and 18 gauge with a copolymer laminate coating.

D365
NIGHT SOIL TREATMENT BY "DENIPAC PROCESS"--KAWAMUKO TREATMENT PLANT, MATSUE CITY (2), (Denipakku purosesu ni yoru shinyo shori-matsue shi kawamulo shorijo),

Ichiki, Y.

Ebara Infuruko Jiho, No. 71, p 15-19, October, 1977. 5 fig, 5 tab.

The patented Ebara-Infilco Denipac process was implemented in 1976 at the Kawamuko Treatment Plant in Matsue City, Japan. The Denipac process removes suspended solids and BOD from domestic wastes treated in the plant. Effective phosphorus and nitrogen removal has been achieved, resulting in high quality effluent and less risk of eutrophication in water bodies. The Denipac process has produced consistent results independent of load variations and waste density. The effluent from the sedimentation has a BOD and suspended solids concentration of 14 ppm, despite a primary dilution rate two to three times lower. High removal rates have been observed for COD due to manganese, BOD, suspended solids, and total nitrogen.

D366
PROCESS DESIGN MANUAL FOR PHOSPHORUS REMOVAL,

1976. 290 p, 53 fig, 57 tab, 178 ref, 2 append. Technical Report EPA-625/1-76-001a.

Chemical precipitation techniques were reviewed for the removal of phosphorus and its precipitate from waste water to prevent eutrophication or overfertilization in receiving waters. The kinetics of phosphorus precipitation by chemical additions were described for the various forms of phosphorus found in waste water. Chemical precipitation of phosphorus before primary settlement was tested with alum, iron, and lime as precipitants. The addition of mineral coagulants to trickling filters, activated sludge plants, and secondary effluents was also studied. Lime was used to precipitate phosphorus in secondary effluent. Parameters evaluated in phosphorus removal by chemical precipitation in pilot and full-scale plants were performance, equipment, designs, and costs. Recommendations on the storage techniques and dosing rates and amounts were presented. Methods were evaluated for sludge handling and dewatering.

D367
THE DEVELOPMENT OF A HYDROPERM (TM) MICROFILTRATION SYSTEM FOR THE TREATMENT OF DOMESTIC WASTEWATER EFFLUENTS,

Sundaram, T. R., Santo, J. E., and Brown, J. A.

Hydronautics, Incorporated,
Laurel, Maryland.

1977. 72 p, 15 fig, 7 tab, 11 ref, 2 append. NTIS Technical Report TR-7658-1.

Cross flow microporous filtration further increases the solids content of already concentrated human wastes. The microfiltration system consists of Hydroperm microporous tubes, developed by Hydronautics, Inc. of Laurel, Maryland, which are constructed of polyethylene, nylon, polyvinyl chloride, or noryl with pores ranging in size from 2-10 microns. Sludge dewatering is enhanced by the addition of an oil to fluidize the waste. The Hydroperm tubes are capable of separating water and oil emulsions, thus achieving up to 98% dewatering. The permeate produced is free of suspended solids and may be polished before discharge. The concentrate may be further dewatered or incinerated directly because of the high hydrocarbon content. The Hydroperm system is cost-effective on a small scale, with a capital outlay of $2,800-5,000 for a 100 liter/day plant. The microfiltration process was developed for use on naval ships and field troop installations.

D368
WASTEWATER RECLAMATION PROJECT, ST. CROIX, U.S. VIRGIN ISLANDS,

Buros, O. K.

Black, Crow and Eidsness, Incorporated,
Cainsville, Florida.

1976. 257 p, 43 fig, 7 tab, 29 ref, 8 append. Technical Report EPA-600/2-76-134.

An economically feasible program of artificial groundwater recharge was accomplished with reclaimed waste water in St. Croix, Virgin Islands. A five-year study was conducted on waste water discharge into the groundwater by spray irrigation and spreading basins as an alternative to sea water desalination as a water supply source. A tertiary treatment plant and recharge facilities were constructed for distribution of the effluent to several test sites. The 0.5 mgd tertiary treatment facility reduced the waste water turbidity to 3 Formazin turbidity units and residual chlorine concentration to 3 mg/liter after 30 minutes of contact. The artificial groundwater recharge sites were located in an alluvial valley and in a marl formation. The artificial recharge program was most effective in the alluvial valley location with spreading basin application of the waste water. The marl formation provided slow infiltration and percolation rates with high evapotranspiration rates. The spreading basins in the alluvial valley operating in a wet cycle had an average sustained rate of infiltration of 14 gpd/sq ft with a groundwater reclamation cost of $2.15/1000 gal. Increasing the capacity of the treatment facility to 1 mgd would reduce the recovery cost to $1.74/1000 gal, compared to $7/1000 gal for desalination of sea water.

D369

MAXIMIZING PHOSPHORUS REMOVAL IN ACTIVATED SLUDGE,

Elliott, W. R., Riding, J. T., and Sherrard, J. H.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Civil Engineering.

Water and Sewage Works, Vol. 125, No. 3, p 88-92, March, 1978. 38 ref.

Improving phosphorus removal in activated sludge by microbial growth, excess uptake, and chemical precipitation was discussed in a review of published experimental data and on-site tests in waste water treatment plants. Laboratory data on microbial uptake identified the C:P ratio as a limiting factor in phosphorus removal; the higher COD:P ratio provided more of the stoichiometric requirement. Variations in mean cell residence time affected phosphorus removal, although the average sludge phosphorus content of 2-3% by weight was not significantly improved. Enhanced phosphorus removal was achieved in plug flow reactors with dissolved oxygen control at pH 6; anaerobic conditions were avoided by adequate sludge removal. Batch studies on excess uptake demonstrated that 80% removal occurred for a low phosphate concentration, 5 mg/liter, in the presence of a high microbial population. The presence of Na(+) and K and the rate of aeration were cited as limiting factors in excess phosphorus uptake. In batch studies, E. coli contained 2.4-4.0% phosphorus by dry weight, indicating that nutrient deprivation improved phosphorus uptake. Full-scale studies verified that phosphorus was released into the effluent stream under anaerobic conditions. Precipitation with CaCO3 resulted in hydrolysis of phosphates at the head of the aeration tank, decreased CO2 generation, and the formation of calcium phosphate sludge. The optimum conditions for phosphorus removal in a plug flow system were concluded to be: pH 7.5-8.5, less than 350 mg/liter CaCO3, and 24 mg/liter Mg(++).

D370

THE PRODUCTION OF PROTEIN FROM MUNICIPAL SLUDGE,

Christiansen, E. B., and Mitchell, D. H.

Utah University,
Salt Lake City,
Department of Chemical Engineering.

AIChE Symposium Series, Vol. 74, No. 172, p 175-181, 1978. 7 fig, 2 tab, 33 ref.

A laboratory technique combining chemical treatment and centrifugation was developed to extract protein from activated sludge. The activated sludge contained about 4-6 g solids/liter, consisting of 6% nitrogen, 34% protein, and 25% ash. The activated sludge suspension was initially centrifuged and then homogenized with deionized water. Further protein release was accomplished by sodium hydroxide treatment at 25 C for 60 min. Solid waste was removed from the suspension by centrifugation; the protein was then coagulated with dilute sulfuric acid at pH 3.0. After the protein precipitate was centrifuged from the liquid, the solids were heated at 80 C for 12 hr to yield a dry product with 42.4% amino acids. Coagulation of the protein at 25 C produced an amino acid content of 43.5% and at 95 C, a product with 48.5% amino acid. Experiments to reduce the high concentrations of heavy metals in the activated sludge were relatively unsuccessful. Further research on heavy metal removal, especially with hydrochloric acid, was recommended. Cost estimates based on 1976 prices were $.395/ib of protein or $0.17/lb of product for an operation handling 12,000 tons of excess activated sludge containing 34% protein/320 day yr.

D371

LOS ANGELES FACES SEVERAL SLUDGE MANAGEMENT PROBLEMS,

Davis, B., and Haug, R. T.

LA/OMA Project,
Whittier, California.

Water and Wastes Engineering, Vol. 15, No. 4, p 37-40, 42, April, 1978. 2 fig, 2 tab, 7 ref.

Alternative methods of sludge treatment and disposal were formulated by the Los Angeles/Orange County Metropolitan Area project of California. Four of the eighteen initial treatment alternatives are discussed. The sludge load from Los Angeles, Los Angeles County, and Orange County is expected to reach 1,540 tons/day by 1985, increasing to 1,785 tons/day by 2020. Long distance transport, a composting-sludge recycle station, thermal processing, and ocean disposal are being considered for sludge disposal. Land application of digested liquid sludge and composted digested sludge would require 80,000 or 30,000 acres, respectively, at agricultural application rates. Sludge would have to be transported to suitable land areas 70-100 miles away or be pumped through a pipeline with pumping lifts. Mechanical dewatering and composting of sludge fully recovers the fertilizer value, providing high cake solids are produced; acreage and location requirements still pose a problem. A sludge-refuse mixture can be thermally processed at the individual treatment facilities, producing sufficient energy to operate the reactor and other treatment facilities. Ocean disposal of sludge can now be performed to a depth of 3,000 ft in basins rather than the current 300 ft depth limit, but additional environmental impact studies are required.

D372

PLANTS AND SYSTEMS FOR COMPOSTING OF SEWAGE SLUDGES IN THE FEDERAL REPUBLIC OF GERMANY--STATE OF THE ART AND TRENDS (Anlagen und Systeme zur Kompostierung von Abwasserschlaemmen in der Bundesrepublik Deutschland--Stand sowie Tendenzen),

Mach, R.

Unweltbundesamt,
Berlin, West Germany.

Muell und Abfall, Vol. 10, No. 1, p 1-9, 1978. 5 fig, 3 tab, 17 ref.

The current status and recent trends in sewage sludge composting in West Germany are reviewed. About 30 composting plants currently in operation in West Germany process sewage sludge alone without municipal refuse. Further increases can be expected in the adoption of sludge composting in view of the steady increase in the number of municipal waste water treatment plants and their associated sludge disposal problems. Composting in rows with or without additives (peat, lime, sawdust, manure, and mushroom mycelium) continues to be of little significance because of the high space requirement, the poor controllability, and the weather dependence of the composting process. Sludge composting in bioreactors is favored because of the small space requirement and ease of process control by monitoring temperature and carbon dioxide concentrations. The patented Kneer system is the most commonly used type of bioreactor in West Germany. Kneer bioreactors produce fresh compost in 2 weeks, providing for temperatures of 60-85 C during the composting process.

D373
NITRIFICATION SYSTEMS WITH INTEGRATED PHOSPHORUS PRECIPITATION,

Sutton, P. M., Murphy, K. L., and Jank, B. E.

Wastewater Technology Center,
Environmental Protection Center,
Department of Fisheries and Environment,
Burlington, Ontario, Canada.

Water and Pollution Control, Vol. 116, No. 4, p 27-33, April, 1978. 6 fig, 2 tab.

Design criteria for nitrifying activated sludge systems with integrated phosphorus precipitation were developed in pilot studies with combined and separate systems. The pilot plants included a two-stage separate sludge system with two 480 Imperial gal aeration tanks and a two-stage combined sludge system having by-passable intermediate clarification and two aeration tanks. The latter unit operated as a separate sludge system when the clarifier returned sludge to the initial aeration tank. Alum or ferric chloride were added to the separate and combined systems in a precipitant:influent phosphorus ratio of 1.0-2.0 with a dissolved oxygen concentration maintained at or above 2.0 mg/liter. Biological equilibrium was maintained with a solids retention time of 8-10 days. The effect of chemical addition at 15 mg/liter on nitrification was insignificant as measured by the amount of filterable total Kjeldahl nitrogen (TKN) in both systems. Both systems generated comparable quantities of nitrate. The geometric mean value of total filterable phosphorus in the precipitant-treated effluent from both plants was 0.35 mg/liter, compared to 2.1 mg/liter in the untreated system. Alkalinity consumption as $CaCO_3$ was 8.0 g/g filterable TKN in the chemically-treated system and 6.0 g/g filterable TKN in the system without chemical precipitation. An additional 1.23 kg of solids was generated in the chemically treated systems. The nitrification rate in the combined and separate sludge systems was determined to be a function of temperature.

D374
AIR VS O2: TWO ACTIVATED SLUDGE SYSTEMS COMPARED,

Miller, M. A.

Environmental Systems,
Union Carbide Corporation,
Tonawanda, New York.

Water and Wastes Engineering, Vol. 15, No. 4, p 58-60, 62-65, April, 1978. 6 fig, 8 tab, 17 ref.

Pure oxygen activated sludge systems and air activated sludge treatment of waste water are compared with respect to differences in sludge quality, production, and dewatering, energy input, and economics of the two systems. Air activated sludge systems operate at a dissolved oxygen concentration of 0.5-2.0 mg/liter; the dissolved oxygen range for the pure oxygen system is 5-8 mg/liter. The higher dissolved oxygen concentration improves oxygen diffusion through the biofloc particles, thus supplying adequate oxygen to the organisms in the biomass. The large supply of oxygen promotes endogenous activity in the biomass and, in theory, the production of exocellular biopolymer and rounded biofloc particles which settle readily and are easily dewatered. High dissolved oxygen concentrations are thought to limit the predominance of filamentous organisms over spherical organisms. Air activated sludge systems have a higher volumetric oxygen demand and require a larger and more efficient aeration tank than pure oxygen sludge systems. Pilot scale systems have demonstrated that oxygen increases sludge settling rates to about 2.5 times faster than in air systems. Higher dissolved oxygen levels promote endogenous respiration in the microorganisms which convert more biomass to carbon dioxide, thereby reducing excess sludge production. The production of exocellular biopolymers contributes to the shape and formation of the biological floc and improves dewatering of the sludge. Operation and maintenance costs for the pure oxygen system are about 20% lower than costs for air systems.

D375

LAWTON ADVANCED WASTEWATER TREATMENT PLANT,

Baker, J. M.

The Military Engineer, Vol. 70, No. 454, p 78-81, March-April, 1978. 2 fig.

The municipal waste water treatment plant recently completed for Lawton, Oklahoma, provides separate sections for primary, secondary, and tertiary treatment to remove high phosphorus and nitrogen concentrations from the raw sewage. The plant has a capacity of 10 mgd with a potential capacity of 13.3-30 mgd with a 15 million gal holding tank for waste storage during overflow conditions. The influent contains: 253 mg/liter BOD, 561 mg/liter COD, 241 mg/liter suspended solids, 28 mg/liter total nitrogen, and 18 mg/liter total phosphorus. Primary treatment consists of screening, degritting, preaeration, and primary clarification. The two-stage secondary treatment process combines circulation of waste water through trickling filters and polyvinyl chloride packed-media towers, followed by nitrification. The nitrification process includes batch aeration and flash mixing of the effluent with lime to maintain alkalinity. Sludge is removed by suction clarifiers and returned to the flow. Phosphorus removal in the tertiary treatment section is accomplished by lime precipitation, with alum and polymer as supplements. The waste water is treated with alum in flash mixers and is then flocculated and settled. This procedure is followed by a two-stage recarbonation with intermediate clarification. Sludge is incinerated, returned to the flash mixers, or wasted in a gravity thickener followed by storage and drying. The final effluent is chlorinated and filtered through sand-anthracite beds. The treated waste water has a BOD of 3 mg/liter, a total phosphorus content of less than 1.0 mg/liter, a nitrate-nitrogen level of 15 mg/liter, and no coliforms.

D376

HUMAN PATHOGENS AS POTENTIAL HEALTH HAZARDS IN THE REUSE OF WATER,

Lund, E.

The Royal Veterinary and Agricultural University of Copenhagen,
Denmark,
Department of Veterinary Virology.

Ambio, Vol. 7, No. 2, p 56-61, 1978. 4 tab, 7 ref.

Methods of removing pathogenic bacteria, viruses, protozoa, and helminths from waste water are reviewed. Salmonella and E. coli are reduced by 50% with primary and mechanical treatment. Parasitic ova and amoebic cysts are removed only through sedimentation in primary or secondary clarifiers. Trickling filter systems, depending on climatic conditions and facility design, can reduce E. coli, salmonella, and sometimes viruses from 10,000,000-1,000,000 bacteria/100 ml to 10,000-100,000/100 ml; Clostridium perifringens are relatively unaffected. A pH of 10.5-11.0, induced by chemical treatment with lime, disinfects treated water but does not reduce mycobacteria or vibrio cholera. Chlorination of sewage effluent effectively kills bacteria, salmonella, Clostridium perfringens, and mycobacteria with adequate contact time but does not destroy enteric viruses and parasitic eggs. Bacteria and viruses in drinking water are effectively removed by chlorination. Pasteurization or irradiation may reduce the concentrated microorganisms contained in primary and digested sludges.

D377

SEWAGE PLANT USES HOLE IN GROUND,

Engineering News-Record, Vol. 200, No. 1, p 12, January, 1978. 1 fig.

Eco-Research Ltd. of Canada has developed a deep shaft aeration and activated sludge treatment system for Virden, Manitoba, Canada. The $1.5 million municipal waste treatment plant with a design capacity of 600,000 gpd employs a 500-ft deep shaft with a 30-inch diameter. Waste water mixed with activated sludge is rapidly circulated within the shaft by compressed air. The aerated, biologically treated waste water is passed to a continuously operating flotation tank for gravity sedimentation of solids. A greater volume of waste water can be treated in less time because of rapid circulation and elimination of settling basin cleaning. The plant is constructed on a 10,000 sq ft site; the shaft was drilled with conventional well drilling equipment. The air compressor is driven by a 2-hp pump which constitutes the major energy demand of the plant. The design of the deep shaft evolved from experiments on the fermentation of methanol for single-cell protein generation with intense aeration.

D378

IMPORTED SEWAGE TREATMENT SYSTEM CLAIMED TO CUT COSTS, ENERGY USE,

Engineering News-Record, Vol. 200, No. 1, p 16, January, 1978.

Designs for the municipal sewage treatment facility in Campbellsville, Kentucky, include installation of a 4.2 mgd Dutch Caroussel activated sludge system. The waste water is aerated and circulated through a baffled oval basin divided into channels with depths up to 15 ft. Aeration and circulation at 1 ft/sec or more are maintained by vertical aerators mounted at one end of the basin. Dilution of the raw sewage in a ratio of 50:1 with mixed liquor stabilizes the biological process under shock load conditions. Capital costs of the Kentucky plant are expected to be 50% lower than those for a conventional activated sludge system with a 20% operational energy savings. The imported Caroussel system converts nitrates into nitrogen gas and oxygen without additional treatment. A 500,000 gpd system that has been operational for one year in a leather tannery in New Hampshire has reduced BOD in the treated effluent to 3-7 ppm.

D379

HYPOCHLORITE GENERATION AT A WATER POLLUTION CONTROL PLANT,

Doan, R. Jr., and Haimes, A. S.

Town Engineer's Office,
Amherst, New York.

Public Works, Vol. 109, No. 1, p 48-51, January, 1978. 2 fig, 1 tab.

Two hypochlorite generators producing chlorine for disinfection of effluent have been included in the design of the 24 mgd waste water treatment plant in Amherst, New York. The Amherst plant will provide secondary and tertiary treatment, as well as postchlorination and prechlorination of effluent. Two 5,000 lb/day Ionics Inc. Cloromat hypochlorite generators will produce an 8% sodium hypochlorite solution from rock salt and brine. As 2,900-3,900 lbs chlorine/day are required by the Amherst plant, in-plant generation of sodium hypochlorite was considered safer than transporting chlorine to the plant. Production of the 8% solution costs a total of $3,345,100, while the required chlorine would cost $5,880,900 if purchased. The Cloromat system, consisting of electrochemical cells containing ion-selective membranes, generates chlorine gas from sodium chloride brine in a titanium-coated anode compartment. The mild steel cathode generates hydroxide ions from water and mixes them with sodium ions from the anode to form caustic solution and hydrogen. Chlorine gas is removed from the brine and hydrogen from the caustic solution by gas-liquid separators. These residuals are reacted to generate sodium hypochlorite which is stored in two 6,000 gal storage tanks. The 100 gpm of cooling water required by the Cloromat system will be supplied by a cooling tower for make-up water.

D380
MAINTAINING DIGESTER BALANCE MAKES FOR ENERGY CONSERVATION,

Public Works, Vol. 109, No. 2, p 82-83, February, 1978.

A method for utilizing sludge digester gas to operate equipment has been developed for the Bay Park waste water treatment plant on Long Island, New York. The 60 mgd treatment facility generates enough methane to furnish the energy requirements of the plant at an estimated power savings of $430,000 over a two-yr period. Odors generated by the activated sludge process with diffused aeration are collected for ozonation treatment. Optimum conditions for methane gas production in the digestors are created by maintaining pH above 6.8, volatile acids below 280 mg/liter and alkalinity above 2,500 mg/liter. The daily dry sludge load of 14 tons generates 500,000 cu ft of digester gas which is stored in a Horton gas sphere. The digester gas is maintained between 92-94 F by engine cooling water that is passed through heat exchangers. An imbalance in optimum conditions for methane production is rectified with the addition of 2,000-2,500 lbs of sodium bicarbonate and a small addition of lime to the grease pit; the grease pit is pumped and cleaned before its contents are discharged to the digester. Enough digester gas is produced daily to operate the three 1,300 hp and one 700 hp diesel turbines which supply plant power.

D381
SINGLE BASIN TREATS SEWAGE SIMPLY,

Engineering News-Record, Vol. 200, No. 15, p 89, April, 1978. 1 fig.

Mixing Equipment Company of Rochester, New York, has begun distribution of a single basin waste water treatment plant with a capacity of 10 mgd. The process employs activated sludge to treat waste water with BOD and suspended solids concentrations up to 3,000 ppm and produces an effluent with less solids than other processes. The plant utilizes a common concrete wall between the aeration chamber and the clarifier at a cost savings. The system has either a surface or submerged aerator which returns settled sludge from the clarifier to the aeration basin. The system reportedly handles biological shock loads by mixing the loads with mixed liquor to prevent overload. Chemicals can be added directly to the basin to effect nitrification and phosphorus removal. The system is equipped with automatic sludge return; sludge produced has properties equivalent to those of aerobically digested sludge.

D382
PERFORMANCE OF CIRCULAR FINAL CLARIFIERS AT AN ACTIVATED SLUDGE PLANT,

Munch, W. L., and Fitzpatrick, J. A.

Metropolitan Sanitary District of Greater Chicago,
Illinois.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 265-276, February, 1978. 10 fig, 2 tab, 10 ref.

The performance of a 38 m-diam circular center-feed clarifier was evaluated under varying conditions of hydraulic and solids loading at an activated sludge treatment facility in Chicago, Illinois. Limiting the effluent flow to 0.66 cu m/sec with a 30% return rate allowed a maximum solids loading rate for efficient clarification of 146 kg/sq m/day at a mixed liquor concentration of 2,500 mg/liter. Higher flow rates were possible when the mixed liquor content was decreased. A higher solids loading rate was accommodated by the clarifier when the hydraulic loading rate was maintained below 0.83 cu m/sec, verifying the dependence of solids loading on hydraulic load. An increase in the thickness of the sludge blanket, occurring at hydraulic loading in excess of 0.83 cu m/sec at a 30% return, threatened the solids separation efficiency of the clarifier. Sludge blanket level, solids settleability, and hydraulic loading reportedly had a greater impact on clarifier solids separation performance than shock hydraulic loading. The actual maximum solids loading rate was significantly lower than the theoretical maximum.

D383
INFRARED SLUDGE INCINERATORS OPERATIONAL IN TEXAS SEWAGE PLANT,

Water and Wastes Engineering, Vol. 15, No. 2, p 23, February, 1978. 1 fig.

A patented infrared sludge incineration process, designed by Shirco, Inc. of Dallas, Texas, has been installed in the Richardson, Texas, sewage treatment plant. Sewage sludge is transported on woven wire belts through two horizontal, insulated incinerators, each 8.5 by 72 ft. The sludge, which is fed into the unit through a feed hopper, is pressed to 1-inch thickness by an internal roller before it is passed into the incinerators. Within the chambers, infrared heating elements incinerate the sludge at a rate of 2,400 lbs/hr. Gas is heated over the ash produced as it passes counter-current to the incoming sludge. The ash is removed for further handling. The modular incineration system has a 1-1/2 hr start up or shut down time.

D384

SLUDGES AND SIDESTREAMS GO HAND-IN-HAND,

Kalinske, A. A.

Camp Dresser and McKee Incorporated,
Walnut Creek, California.

Water and Wastes Engineering, Vol. 15, No. 2, p 25-27, February, 1978. 1 ref.

The characteristics of waste water sidestreams generated by sludge stabilization, thermal disposal, drying, composting, landfilling, land application, and advanced waste water treatment are discussed. Stabilization of sludge by aerobic, anaerobic, lime, or heat treatment can produce a waste stream with BOD concentrations ranging from 1,200-10,000 mg/liter, phosphorus levels from 150-700 mg/liter, and ammonia-nitrogen contents from 400-1,000 mg/liter. Thermal destruction of sludge, which is conditioned with polymers or lime and ferric chloride to reduce soluble BOD, produces gaseous emissions which are scrubbed with water. These sidestreams, containing volatile organics, are treated with chemical coagulation and settlement before discharge. Leachate from drying beds contains high concentrations of BOD and ammonia which should be prevented from percolating into aquifers or washing out with surface runoff. Composting of sludge can result in a sidestream of waste water resulting from storm water runoff; total enclosure of compost sites and collection of runoff are recommended. Pathogens, heavy metals, and chlorinated hydrocarbons are present in leachates from landfill disposal of sewage and industrial sludges. Sewage sludge applied to land contains toxic metals and organics that are solubilized by rainwater which carries the toxins into surface and groundwater. Waste water sidestreams are generated by advanced treatment such as carbon adsorption, electrodialysis, and ion exchange or reverse osmosis.

D385

CLEVELAND PUSHES TO MEET STRICT EFFLUENT LIMITATIONS,

Ungar, A. T., and Patrick, D.

Cleveland Regional Sewer District,
Ohio.

Water and Wastes Engineering, Vol. 15, No. 2, p 57-60, February, 1978.

Four sewage treatment facilities, with a combined capacity of 251.6 mgd, treat the municipal wastes, storm water, and sludge in the Cleveland, Ohio, area. The largest treatment plant, based on the activated sludge method, receives wastes which average 125 mg/liter BOD and 135 mg/liter suspended solids. Sludge produced by the plant is pumped 13.2 miles through a 12-inch cast iron force main to the next largest treatment facility for final treatment at a rate of 1,200-1,400 gpm. Sludges from both plants currently undergo primary settlement, anaerobic digestion, and vacuum filtration. The incinerators, which normally dispose of the sludge, are being modified to incinerate up to

400 tons sludge/day. Further treatment in addition to current practices includes cyclone degritting, gravity thickening, centrifugation, and sludge conditioning with ferric chloride and lime or polymers. The 35 mgd treatment plant employs 64 Imhoff primary treatment tanks, primary digestion, and vacuum filtration. A physical-chemical treatment plant with a 50 mgd dry weather flow and a 100 mgd wet weather capacity, is planned. The smallest 1.6 mgd treatment plant will be operated until interceptor lines are constructed to transport wastes from the area to the second largest facility.

D386

OZONE PLANT IMPROVES EFFICIENCY AND ECONOMY OF WASTEWATER TREATMENT,

Stopka, K.

U.S. Ozonair Corporation,
San Francisco, California.

Water and Sewage Works, Vol. 125, No. 4, p 54-59, April, 1978. 4 fig, 9 tab.

A three-month field testing program was used to evaluate ozone concentrations and dosages in waste water treatment. The study also examined the feasibility of using ozone in small quantities as a source of nascent oxygen in aeration. Air enriched with 5 mg/liter ozone was applied to effluent in a contact vessel for 15 min of equalization and 30 min of treatment time. The oxygen supplied by the ozone stimulated the growth of aerobic organisms and suppressed the growth of anaerobes. When the ozone dosage was increased to 10 mg/liter, the enhanced bioflocculation effect was replaced by sterilization. The higher solubility of ozone/air mixtures was reported to reduce air requirements, energy expenditures, and contact times to below those required for aeration or pure oxygenation. Ozone treatment at a concentration of 2% by weight was considered to be effective for deodorization in municipal and industrial waste treatment. Criteria were recommended for the design of an ozone plant, covering such topics as air preparation, ozone-producing electrode specifications, air moisture, and ozone contractor performance.

D387
EFFECT OF GAMMA RAYS ON MICROORGANISMS AND CHEMICALS IN WATER, WASTEWATER, AND SLUDGE,

Woodbridge, D. D., and Cooper, P. C.

Florida Institute of Technology,
Melbourne,
University Center for Pollution Research.

1976. 175 p, 59 fig, 31 tab, 64 ref. NTIS Technical Report AD/A-029-680.

Gamma irradiation of secondary trickling filter effluent was evaluated in conjunction with air and oxygen bubbling, ozonation, and prechlorination for the treatment of bacteria and chemicals in waste water. Chemicals reduced by irradiation included: phenols, detergent surfactants, parathion, and cyanide. Dissolved oxygen and free chlorine were removed; chloroform and carbon tetrachloride, byproducts of chlorination, were eliminated by irradiation and simultaneous oxygen bubbling. The destruction of coliforms by irradiation was enhanced in the presence of air or oxygen bubbling; chlorination before irradiation also had a synergistic effect. Irradiation was more effective in reducing coliforms in aqueous media than in sludge; undigested sludge was more treatable with gamma irradiation than digested sludge. Irradiation inactivation of the pathogenic bacteria, Streptococcus faecalis and Staphylococcus aureus, and the pathogenic amoeba, Naegleria gruberi, was tested. Further research was recommended for pathogens and viruses.

D388
A NOVEL CLARIFIER FOR DILUTE PROCESS STREAMS,

Flynn, P. J., and Boadway, J. D.

Industrial Water Engineering, Vol. 15, No. 1, p 19-22, January-February, 1978. 7 fig, 1 tab, 3 ref.

The Vortex Clarifier, an automatic batch centrifuge developed by Queen's University, Kingston, Ontario, and Bird Machine Co., Inc., was found effective in reducing suspended solids of 1,000 ppm or less in municipal and industrial waste streams. The Vortex Clarifier separates the waste stream which is moved axially between two rotating cylinders. The settling vanes and bowl, which rotate at the same speed, create a fixed vortex in the liquid passing through a separator for particulate migration toward the bowl wall. The settling vanes enhance the removal of fine particles, reducing the internal turbidity in the liquid vortex. Sufficient accumulation of particulate matter enacts the solids discharge cycle. The Vortex Clarifier reduced suspended solids in a mixed municipal and industrial waste stream at a 12 mgd municipal treatment plant by 80%. Suspended solids levels in the filtrate from two vacuum filters were reduced by 97%. Polishing of secondary clarifier overflow by the centrifuge unit reduced suspended solids from 15-24 ppm to 5-8 ppm. Suspended solids in an industrial waste stream containing talc and water were reduced by 97% in the clarifier and by 91% for the settling tank effluent.

D389

HEAVY METALS IN WASTE WATERS FROM THE CITY OF ZURICH (Schwermetalle in den Abwaessern der Stadt Zuerich),

Hegi, H. R., Krahenbuhl, H. R., Liebi, C., Roberts, P. V., and Weber, A.

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasser-reinigung und Gewasserschutz,
Duebendorf, West Germany.

Gas-Wasser-Abwasser, Vol. 57, No. 11, p 799-804, 1977. 10 tab, 3 fig, 18 ref.

Heavy metal concentrations were monitored in influent and effluent from two waste water treatment facilities in Zurich, Switzerland. The heavy metals measured in daily and weekly influent, effluent and sludge samples included: lead, cadmium, chromium, copper, nickel, and zinc. Influent concentrations averaged 0.1 mg/liter of chromium, copper, lead, and nickel; 0.5 mg/liter of zinc and 0.01 mg/liter of cadmium. Heavy metal removal by the treatment process averaged from 60-80%. Corresponding heavy metal concentrations were found in the digested sludge from the waste water treatment plants. Mean concentrations measured in the sludge were 3,000 mg/kg dry matter for zinc; 300-800 mg/kg dry matter for chromium, copper, nickel, and lead; and 20 mg/kg for cadmium.

D390

REMOVAL OF HEAVY METALS VIA OZONATION,

Shambaugh, R. L., and Melnyk, P. B.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 113-121, January, 1978. 10 fig, 2 tab, 27 ref, 1 append.

Rate constants were calculated for the second-order reaction of aqueous ozone with free and complexed heavy metals. The rate constants were dependent upon ozone concentrations determined by ozone transfer between gas and liquid, the reaction of ozone with free or complexed metals, and the degradation of ozone in the aqueous solution with respect to pH. Ozonation of heavy metals was examined for ethylenediaminetetracetic acid (EDTA)-complexed manganese, cadmium, nickel, and lead, and uncomplexed lead, manganese, zinc, nickel, cobalt, and barium. Ozone contact times of 10 min were sufficient to break down the EDTA-complexed metals. Uncomplexed metals with high oxidation states were rendered less soluble after 1 min of ozonation. The second-order rate constant for the ozonation of uncomplexed lead and other metals was estimated to be greater than 1 billion cu cm/mole-sec. The reaction rate of ozone with the EDTA-complexed metals was an order of magnitude faster than for ozonation of the EDTA alone.

D391

ENHANCEMENT OF PHOSPHORUS REMOVAL THROUGH IRON COAGULATION FOLLOWING LIME PRECIPITATION,

Cavagnaro, P. V., Work, S. W., Bennett, E. R., and Linstedt, K. D.

Consoer, Townsend and Associates,
Chicago, Illinois.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 95-100, January, 1978. 5 fig, 2 tab, 8 ref.

Lime and iron coagulant additions to waste water were tested as a means of removing phosphorus and reducing sludge and lime quantities. Lime was added to unchlorinated secondary effluent, in doses of 50, 100, 150, 200, 300, and 400 mg/liter, followed by ferric chloride in doses of 0, 1.0, 2.1, 4.2, 6.2, and 8.5 mg/liter. The treatment process consisted of rapid mixing with the coagulant conditioners, followed by flocculation and settling. Particulate phosphorus was completely removed at all of the lime dosage rates used in conjunction with iron; 360 mg/liter lime without ferric chloride additions reduced total phosphorus to 0.7 mg/liter. The same total phosphorus concentration was achieved with 180 mg/liter lime when 4.1 mg/liter ferric chloride was added. The quantity of sludge generated from lime treatment without iron was 2.5 tons/million gal which was reduced to 1.2 tons/million gal with iron coagulations. The lime and ferric chloride additions significantly improved suspended solids removal and had a slight effect on COD and bacteria reductions.

D392

AN OVERVIEW OF LAND TREATMENT FROM CASE STUDIES OF EXISTING SYSTEMS,

Uiga, A., and Sletten, R.

United States Cold Regions Research and Engineering
Laboratory,
Hanover, New Hampshire.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 277-285, February, 1978. 3 fig, 3 tab, 16 ref.

Four land application systems of waste water disposal are discussed with respect to the varying climatic conditions the systems encounter. Untreated and undisinfected municipal wastes from Calumet, Michigan, averaging 1.2 mgd annually, are applied by rapid infiltration to percolation basins. Calumet's average annual temperature is 4.4 C with a total yearly precipitation of 5,380 mm. Primary, undisinfected effluent from Quincy, Washington, is applied at rates up to 15 cm/wk to four cropped fields and one fallow field by open ditch gravity distribution. The annual temperature in Quincy averages 9.4 C with an annual rainfall of 200 mm. Manteca, California, wastes receive secondary treatment without disinfection and are applied at a rate of 45.0 mm/wk by flooding to a 160-acre site covered with ryegrass. Temperatures in Manteca average 16.1 C with a yearly precipitation of 280 mm. At the fourth site in Livermore, California, treated effluent is applied from April to October to a municipal golf course, to land adjacent to the airport runways, and to crops. Applications of 13.0 mm to half of 100-acre golf course every other day, 610-910 mm/season to 45 acres of crops, and 13.0 mm/day for 2-4 wks to 55 acres of adjacent runway land are performed over the season. Temperatures in Livermore average 15 C with an annual rainfall of 380 mm. Land application of waste water in Calumet and Livermore efficiently removed all detectable phosphorus while levels remained high in the soil waters at the Quincy and Manteca sites. Nitrate-nitrogen concentrations at the four sites were on the average below 10 mg/liter nitrate. Trace metal accumulations were low in all four sites due to the absence of industrial wastes. Cost data and specific site problems were also discussed.

D393
THAMES WA OUTLINES ITS COST STUDY ON SLUDGE,

Surveyor, Vol. 150, No. 4455, p 18, October, 1977. 1 tab.

Methods and costs of sludge treatment were analyzed by England's Thames Water Authority. Of the Water Authorities' 305,000 tons of dry solids (tds) produced from their annual 10 million tons sludge/yr, 154,000 tons are applied to agricultural land and 51,000 to land reclamation or fill. Sixty-nine percent of these solids are treated with heat digestion. The remaining sludge is reduced by mechanical dewatering, sludge thickening lagoons, or shipped to sea for disposal. The total cost, for a population of 500,000, of treating primary and secondary sludge by heat digestion is 14 pounds sterling/tds; by lime stabilization, 3-5 pounds/tds; by earth-banked dewatering lagoons, 6.7 pounds/tds; and by mechanized drying beds for digested sludge only, 52 pounds/tds. Vacuum filtration produces a sludge containing 18-20% dry solids at 10 pounds/tds. An 18-20% dry solids sludge costs 14 pounds/tds by centrifugal dewatering. Band or belt presses dewater sludges to 25-35% dry solids at an expense of 17 pounds/tds, while filter presses achieve a dry solids content of 35-40% at a cost of 19 pounds/tds. Incineration of sludge from populations of 100,000 and 500,000 costs 159 and 74 pounds sterling/tds, respectively.

D394
50 YEARS' EXPERIENCE OF SLUDGE DEWATERING,

Water Services, Vol. 81, No. 975, p 292-293, May, 1977.

Sludge dewatering techniques developed over a 50-yr period by Edwards and Jones Ltd. of Stoke-on-Trent, England, are discussed. The plate filter press, developed 50 yrs ago, was completely mechanized in the 1960's and fitted with steel-reinforced molded rubber trays and push button operation. Polymer applications to sludge were investigated as an alternative to ferric sulfate, aluminum chlorohydrate, and lime conditioning. A patented in-line polymer dosing apparatus that did not require separate pumping equipment was designed by Edwards and Jones Ltd. Modification of the belt press, which produces a sludge cake with a high solids content, resulted in the development of the continuous filter press. This press provides the high pressure of the plate press within the design of the belt press and is suitable for liquid-solid separation of most wastes. The continuous filter press is reportedly easily integrated into an on-line continuous sludge dewatering system.

D395
MARSH/POND SEWAGE TREATMENT PLANTS,

Small, M. M.

Department of Applied Science,
Brookhaven National Laboratory,
Upton, New York.

1976. 15 p. NTIS Technical Report BNL-21237.

A marsh/pond sewage treatment system which purifies waste water to potable water standards at the Brookhaven National Laboratory in Upton, New York, is described. A prototype 10,000 gpd treatment system required 0.2 acres of marsh at a 1-ft depth followed by an 0.2 acre pond with a 5-ft depth. The system was completely underlined with a 20-mil polyvinyl chloride membrane to prevent groundwater infiltration of the waste water. A blend of sewage and septage is applied to the marsh at a rate of 50,000 gal/acre/day; a 20-acre site is required to treat 1 mgd. The marsh is planted with grasses, duckweeds, and cattails, although the continued growth of the cattails has been unsuccessful. The marsh/pond treatment system has been developed for populations up to 10,000, costing an estimated $0.60/gal/day for operation.

D396
EVALUATION OF FLOW EQUALIZATION AT A SMALL WASTE-WATER TREATMENT PLANT,

Foess, G. W., Meenahan, J. G., and Harju, J. M.

Johnson and Anderson, Incorporated,
Pontiac, Michigan.

1976. 57 p, 11 fig, 11 tab, 12 ref. Technical Report EPA-600/2-76-181.

The impact of flow equalization on a 2.1 mgd activated sludge waste water treatment plant was evaluated at the Walled Lake/Novi, Michigan, municipal treatment facility. The flow equalization system created uniform diurnal flow rates over the one-week testing period. Concentrations of ammonia-nitrogen, soluble orthophosphate, BOD, and total suspended solids in the equalized flow were not significantly different under process equalization from those of the raw influent. Mass levelling in the trial system occurred as a result of flow equalization rather than improved blending. A two-week study of the treatment process in the two waste flows was evaluated by comparing clarifier effluent. After filtration, BOD was reduced in the equalized flow to 4 mg/liter; BOD averaged 7 mg/liter in the raw influent. Other comparisons of parameters in the two waste streams showed similar reductions by both systems. The overall quality of secondary clarifier effluent was slightly higher in the equalized flow system than in the unequalized system.

D397

MASS TRANSFER AND REACTION RATE STUDIES OF OZONATED MUST WASTEWATERS IN THE PRESENCE OF SOUND WAVES,

Sierka, R. A.

Arizona University,
Tucson,
Department of Civil Engineering.

1976. 143 p, 31 fig, 7 tab, 14 ref, 5 append. NTIS Technical Report UA-ENGR-1436.

Ultrasonic waves were investigated for the treatment of synthetic, ozonated, and U.S. Army field hospital (MUST) wastes; reverse osmosis permeates; sodium acetate; urea; and Kodak X-ray developer and fixer. Ultrasonic treatment assisted in the decomposition of ozone, thus lowering the dissolved oxygen concentration. Mass transfer coefficients for ozone increased from 49.7 to 65.9/hr with ultrasound. While the organic stripping of MUST permeates was relatively unaffected by ultrasonic waves, ultrasound increased the rate and extent of ozone oxidation of the permeates in the higher and lower peak envelope power ranges. Total organic carbon and COD were reduced to 5 mg and 10 mg/liter, respectively, within two hrs at an ozonation rate of 236.4 mg/min with ultrasound. COD and total organic carbon level standards in permeates were achieved with a combination air stripper and ozone reactor which utilized 35% less ozone than a continuous ozonation system but required a longer reaction time. Ultrasonic treatment of sodium acetate improved its oxidation; urea, developer, and fixer solution oxidation was not significantly enhanced. The Kodak solutions could be oxidized before reverse osmosis treatment in the presence of sufficient ozone.

D398

FRESH WATER FROM SEWAGE ON LONG ISLAND,

Small, M. M.

Department of Applied Science,
Brookhaven National Laboratory,
Upton, New York.

1977. 16 p, 10 ref. NTIS Technical Report BNL-21571.

Sewage and cesspool contents were used to recharge groundwater in studies at the Brookhaven National Laboratory in Upton, New York. The waste water purification system was a sloping grass meadow draining into a planted marsh and eventually into a fish-stocked pond. The sewage was applied to the meadow where it permeated the soil and plant roots. The waste water passed through the marsh soils, plant stalks, and roots before flowing into the pond. Overflow from the pond was usable as potable water. The same degree of purification could be attained by a marsh/pond system where meadowland is not available and there is a high population density. Both systems were completely lined so the waste water could not percolate into the groundwater before purification. The system produced no sludge or odor. The marsh/pond sewage treatment system costs an estimated $1,440,000, compared to $640,000,000 for a municipal sewage treatment plant.

D399

A NEW METHOD OF WASTEWATER TREATMENT: INTERMITTENT SUBMERGED BIOOXIDATION,

Nagatani, M., Nakagawa, H., and Nunokawa, Y.

Yonetsuru Shuzo Company Limited,
Yamagata, Japan.

Hakoo Kogaku, Vol. 56, No. 2, p 127-132, 1978. 5 fig, 1 tab, 2 ref.

An intermittent submerged biooxidation system utilizing microbial slime attached to plastic plates which are alternately submerged and exposed to air was tested for use in small-scale waste water treatment plants. The plastic plates, with a total surface area of 0.5 sq m available for microbial slime, were mounted in two 5 liter vessels which were operated in 24 hr batch cycles. Waste water introduced into the first tank was drained to the second tank and then back to the first at 15 min intervals. The microorganisms thus received alternate supplies of nutrients and oxygen. The COD concentration of waste water initially containing less than 21 g/sq m/day was reduced by 90% with the biooxidation system. The oxygen uptake rate of the microbial slime was measured as 22.2 g/sq m/day by a membrane oxygen sensor after air within an empty vessel was circulated at 1.3 liter/min. The oxygen uptake rate of a slime-free wet surface using the same apparatus was measured as 7.4 g/sq m/day by the sulfide oxidation technique, verifying higher oxygen absorption rates due to the presence of microbial slime in the intermittent submerged biooxidation system.

D400

RESULTS OF INVESTIGATIONS OF OPERATION TECHNIQUES, OPERATIONAL SAFETY, TECHNOLOGY AND ECONOMICS OF THE BIOREACTOR FOR SEWAGE SLUDGE ROTTING (Ergebnisse der Untersuchungen ueber Betriebstechnik, Betriebssicherheit, Technologie und Wirtschaftlichkeit am Bioreaktor zur Abwasserschlammverrottung),

Woerle, R.

Bayerisches Landesamt fuer Umweltschutz
Munich, West Germany.

Muell und Abfall, Vol. 10, No. 1, p 12-19, 1978. 6 fig, 3 tab.

The performance of a pilot-scale aerated bioreactor to produce compost from sewage sludge and sawmill wastes was evaluated. Reactor performance was examined during three phases, including: charging of the reactor; operation with complete product return and continuing aeration; and steady-state operation with discharge, partial product return, and addition of fresh sewage sludge and sawdust. A carbon-to-nitrogen quotient of 31-33, the optimum level for the composting process, was maintained by adequate mixing of the sludge and sawdust. Temperature and carbon dioxide concentrations in different reactor zones correlated well with biological processes, indicating that these parameters could be used as control variables for oxygen input. Tests on the effects of raw and cured compost on the growth of cress revealed that curing for approximately two months in the bioreactor would significantly enhance the fertilizer value and thereby improve plant growth.

D401

THE OPERATION OF THE ZIMPRO THERMAL CONDITIONING WITH AIR SLUDGE PLANT AT KWA DABEKA (CLERMONT) SEWAGE WORKS,

Antoni, G. F.

Water Pollution Control, Vol. 77, No. 1, p 75-78, 1978. 1 fig, 4 tab.

A cost and performance analysis was presented for the Zimpro thermal sludge conditioning system installed at the Kwa Dabeka sewage treatment plant in Natal, South Africa. The Kwa Dabeka facility, with a planned capacity of 18,200 cu m/day, produced raw sludge containing 3-6% solids; sludge liquors and vacuum filter filtrate were returned to the head of the works. The Zimpro system passes settled raw sludge through disintegrators to heat exchangers and a thermal reactor. After decompression, sludge is pumped to a catalyst furnace; oxidized sludge is transported to a vacuum filter which separates the sludge cake from the supernatant liquor. The Zimpro system cost about 400,000 rands less than conventional sludge treatment processes and required less land.

The filtration properties of the sludge were also improved by thermal oxidation. Capital costs for the sludge dewatering plant were 440,600 rands, 62,200 rands more than estimated. Annual operating costs of the Zimpro system without sludge dewatering and supernatant liquor treatment were 17,051 rands, at a unit cost of 3.79 rands/kiloliter raw sludge. Thermally oxidized sludge liquors contained an estimated 6,180 mg/liter BOD and 12,360 mg/liter COD at a pH of 4-9. Operational problems encountered during 1975, the first year of operation of the Zimpro system, included collapse of the gearbox in the oxidized sludge stirrer mechanism, grit abrasion of the piston seals and sleeves of the high-pressure pumps, and line blockage due to large amounts of rags and other materials in the influent to the raw sludge tanks.

D402
ABATEMENT OF ODOR IN SEWAGE WORKS--DETERMINED IN HEIDELBERG (Geruchsbekaempfung in Kompostwerken am Beispiel Heidelberg),

Jaeger, B., and Jager, J.

Fachgebiet Abfallwirtschaft der Technischen Universitaet Berlin,
Berlin, Germany.

Muell and Abfall, Vol. 10, No. 2, p 48-54, 1978. 6 fig, 3 tab, 11 ref.

The Heidelberg refuse and sewage composting plant generated malodorous emissions which were a nuisance to the residents of the community located 400 m from the plant. Feasibility and cost studies of various alternatives for odor abatement revealed the distinct advantages of odor control by means of compost bed filters with surface areas of 200 sq m. The compost filters proved to be efficient and reliable. The overall treatment efficiency relative to concentrations of organic carbon before and after filtration was 93%. Removal efficiencies for specific emission components were: 100% for ethanol, diacetyl, and acetone; 72% for limonene; and about 50% for other compounds.

D403
THE EURO-MATIC BIO-DRUM PROCESS,

Holmberg, L.

European Plastic Machinery Manufacturing,
Copenhagen, Denmark.

Tribune du CEBEDEAU, Vol. 30, No. 409, p 437-441, December, 1977. 6 fig, 1 tab.

The design of the Euromatic Bio-Drum incorporates principles of both the trickling filter and the rotating contact filter for biological waste water treatment. The Bio-Drum utilizes plastic balls held together in the shape of a drum by a metal net; the drum is free floating because of the low specific gravity of the plastic media. Containers built into the periphery of the drums lift waste water out of the aeration tank, as well as trap air which is taken down into the tank and bubbled through the drums. The drums can be adjusted to varying levels of waste water and speeds of rotation; the system provides 100% moistening of the biological filter media. BOD removal efficiencies by the microbial film supported on the plastic balls in the Bio-Drum have been about 85% and as high as 95% when sludge is returned to the system. Activated sludge flocs are easily separated from the water; 100% settling has been achieved within 30 min. The Bio-Drum removes 3-4 kg BOD/killowatt-hour, compared to 1 kg BOD/kilowatt-hour for conventional activated sludge systems. Two systems are in operation in Denmark; the Bio-Drum is also being tested for recirculating fish breeding pond water.

D404

HOLDENHURST: OXYGEN BOOST TO SEASIDE WORKS.

Rees, J. T.

Surveyor, Vol. 151, No. 4471, p 17-20, February, 1978.

A Vitrox oxygen injection unit was installed in the Holdenhurst sewage treatment plant, under the jurisdiction of England's Wessex Water Authority, to improve nitrification in the effluent. The plant was upgraded from a capacity of 13.6 million liters/day to 27.2 million liters/day with provisions for an additional 6.0 million liters/day to accommodate higher sewage loads during the summer months. After the waste water was degritted and pulverized, it flowed through six settlement tanks to two activated sludge plants; a 12,000 cu m/day portion received further treatment by three nitrifying filters. The final effluent should have contained 15 mg/liter BOD, 20 mg/liter suspended solids, and 20 mg/liter ammonia-nitrogen. BOD levels were found to be higher than anticipated because of incomplete oxidation of nitrogenous material; dissolved oxygen levels were below the minimum 4% in the aeration channels. A fourth nitrifying filter was installed and the first aeration unit was limited to carbonaceous oxidation. The second aeration unit was upgraded with the Vitrox system injecting 4 tons oxygen/day. Mixed liquor suspended solids were increased to 3,000 mg/liter in the aeration units; final effluent was pumped into six storm tanks with a combined capacity of 6,820 cu m to eliminate the effects of denitrification. Three additional Vitrox units were subsequently installed to upgrade the first aeration unit. Odor problems arising from the plant were abated by Vitrox injection of 0.75 tons of oxygen/day into degritted influent.

D405
STUDY OF THE INFLUENCE OF ACTIVATORS ON THE PURIFICATION EFFICIENCY OF SEPTIC TANKS (Etude de l'action des activateurssur l'efficacite d'epuration des fosses septiques),

Chelle, R., and Bazerque, F.

SETRIC,
Toulouse, France.

Techniques et Sciences Municipales - l'Eau, Vol. 73, No. 1, p 43-47, January, 1978. 5 fig, 1 tab, 2 ref.

Organic and inorganic additives were tested for their ability to improve septic tank sewage treatment. Biodegradable activators which can be assimilated by bacteria and stimulate microorganism growth were found to improve the performance of septic tanks, both at the initial startup phase and at restart after accidental poisoning of the septic tank microflora. The activators, containing concentrated bacteria and nutrients, shortened the length of time required to achieve a high degree of purification in terms of COD removal. Mineral additives increased the suspended solids content of the septic effluent without increasing the degradation of organic matter. Bacteria seeding was especially effective for temperatures below 15 C where the growth rate of the bacteria in the additive far surpassed that of naturally occurring sewage bacteria.

D406
IS CHLORINE THE BEST DISINFECTANT?,

The American City and Country, Vol. 93, No. 3, p 82-83, March, 1978. 1 fig.

Dechlorination, ozonation, chlorine dioxide, ultraviolet light, bromine chloride, and iodine are investigated as alternative disinfectants to chlorine which has been found toxic to some aquatic organisms, to form carcinogenic halogenated organic compounds, and to pose a potential health hazard in transport and in storage. Dechlorination with sulfur dioxide can reduce the pH and dissolved oxygen content of the effluent, which then requires further treatment before discharge. Ozonation is a more costly procedure than chlorination but it is not toxic to aquatic organisms, assists in increasing the dissolved oxygen content, and provides adequate disinfection. Contactors under investigation for ozonation include baffled diffusers, positive-pressure injection systems, turbine contactors, bubble diffusers, and multi-stage mixing pumps. Chlorine dioxide disinfection requires on-site generation equipment. While chlorine dioxide does not form halogenated compounds, does not react with ammonia in the waste water, and disinfects efficiently and selectively at high pH levels, it is more toxic than chlorine. Ultraviolet light disinfection is efficient at high doses, produces no toxins, and can disinfect turbid or colored water. Bromine chloride, which forms bactericidal and viricidal bromines when reacted with ammonia, produces some monohalogenated compounds which are more degradable than chlorinated compounds. Bromine chloride disinfection also has the advantage of rapidly killing poliovirus. Iodine disinfection, currently under investigation, is considered prohibitively expensive.

D407

CAN CALIFORNIA COPE WITH ITS MOUNTING SLUDGE VOLUMES,

Wassermann, K. L.

State Office of Water Recycling
Sacramento, California.

Civil Engineering-ASCE, Vol. 48, No. 2, p 60-65, February, 1978. 2 fig.

Alternatives to ocean disposal of sewage sludge from the major metropolitan areas in California were investigated by the Los Angeles/Orange County Metropolitan Area project and the San Francisco Bay Regional Wastewater Solids Study. The Los Angeles Hyperion Treatment Plant discharges 1.2 mgd of sludge through a 7 mile long outfall to a submarine canyon. The 40 acres of land formerly employed by the Los Angeles County Sanitation District for winnows in the composting of sludge are required for plant expansions. The San Francisco Bay area disposes of 55% of its sludge in landfills, 30% in storage lagoons, 10% by incineration, and 5% as soil conditioner. Ocean disposal of sludge in California has been banned by 1980 and real estate costs are becoming prohibitive. An extimated 16,000 acres of farmland would be required for land application of all the sludge produced. Anaerobically digested sludge, dewatered to 20% solids content, can be composted and sold for domestic and commercial landscaping. Sludge must have a 25-40% solids content for efficient combustion; thermal processing can produce polychlorinated biphenyls and vaporized mercury as well as other air pollutants. Improved thermal processing techniques are under investigation. Pyrolysis of sludge generates gases which can be used as a fuel source in plant operations but pilot plant studies have indicated problems with the technique.

D408

ULLSWATER INSTALLATION,

Effluent and Water Treatment Journal, Vol. 18, No. 3, p 105, March, 1978.

A Klargester BioDisc waste water treatment plant with a daily capacity of 10.8 cu m has been installed at the Helvellyn youth hostel in Ullswater, England. The 5.4 by 2.7 m BioDisc has a height of 3.2 m, of which 0.5 m is visible above ground. The Cellobond glass-reinforced polyester resin unit weighs 2.8 tons and is suitable for remote locations, such as the youth hostel which is 1,100 ft up the Helvellyn mountain. The BioDisc sewage treatment plant was installed within 30 min and tripled the sewage treatment capacity of the hostel. The sewage treatment plant can handle waste water with organic loads up to 4.08 kg/day BOD.

D409
THE OXFAM SANITATION UNIT,

Howard, J., and Lloyd, B.

Oxfam,
Oxford, England.

Proceedings of the Royal Society of London Series B, Vol. 199, No. 1134, p 179-182, 1977. 1 fig.

The patented Oxfam sanitation unit is a three-stage plastic waste water treatment plant which does not require a power source and reduces pathogenic organisms. Each unit, servicing 500 people, contains: a latrine area, partially constructed from the unit's wooden shipping crate; nylon-reinforced butyl rubber tanks for sewage containment and anaerobic treatment; and an aerobic percolating filter composed of 50-75 mm locally obtained pieces of brick or stone. The filtrate from the process drains into a trench or drain. The Oxfam unit was tested with wastes from the Cholera Research Laboratories in Dacca, Bangladesh. Cholera, coliform, and salmonella populations were reduced to .01 of their original counts. Ascaris and Trichuris ova were undetected in 100 ml of effluent. The treatment unit, with an estimated life span of 5-10 yrs, costs about 5 pounds sterling per capita.

D410
THE HOUSTON SOLUTION: ADVANCED TREATMENT AND SLUDGE RECLAMATION,

Public Works, Vol. 109, No. 2, p 104, February, 1978.

A two-stage activated sludge plant has been selected for treating waste water from a 53,500 acre section of Houston, Texas, containing one-third of the city's population and most of the business district. The first stage of the plant, following degritting and trash removal, reduces carbonaceous BOD by the activated sludge process. The second stage promotes nitrification with pure oxygen generated on-site in a cryogenic oxygen plant. The waste water then flows by gravity through rapid media filters followed by chlorination and discharge to the Buffalo Bayou and the Houston Ship Channel. The sewage sludge is thickened, aerobically digested, dewatered by vacuum filtration, and dried. An average of 112 tons/day of sludge is processed at the plant which has provisions for a peak capacity of 140 tons/day. The processed sludge is sold as commercial fertilizer. Sixty million dollars of the $220 million plant was allocated for the sludge processing plant.

D411
S. HANTS' SEWAGE GIANT,

Surveyor, Vol. 151, No. 4473, p 8-9, March, 1978.

The regional sewage treatment facility and outfall planned for the communities of South Hampshire, England, are detailed. The sewage system will treat wastes from six districts and will have an ultimate capacity for servicing a population of 940,000. The first of four stages of construction includes: inlets and screw pumps, screens, coarse solids channels, six primary and storm water settling tanks, four parallel streams with diffused aeration, and four final settling tanks. Belt press dewatering of the sludge will be followed by fluidized bed incineration in a brick rather than asbestos building to reduce noise. The 5-km long outfall with a 3-m diameter will be constructed in a precast concrete culvert and will extend 1,000 m into the Lee-on-Solvent. The plant will have a capacity of 57 mgd with provisions for treating up to 5.5 times the dry weather flow with primary settling. Gravity sewers will transport sewage flows from the eastern and western sections of the region to a pumping station where they will be combined, lifted, and passed by gravity sewers to the treatment plant. The total cost of the completed project is estimated to be 95 million pounds sterling.

D412
SPREADING SLUDGE,

Surveyor, Vol. 151, No. 4469, p 22, February, 1978.

A sludge spreading tanker with a 10-ft sludge outfall capability has been ordered by the Thames Water Authority in England for the application of wastes to land. The tanker is manufactured by Fergussons (Tankers) Ltd. of Portsmouth, Hampshire, England, and equipped with an engine mounted on an M-type Bedford chassis. The spreader utilizes fan-shaped plates for even sludge application. A Metalastic bush on the front of the truck and heavy duty outriggers on the back support the 1,300 g mild-steel tank which contains dished and flanged internal anti-surge baffles to distribute the strain on the knuckled radius. The tank webs have returned edges for extra strength. Two Reis 4-inch discharge slide valves at the rear of the tanker have stainless steel blades and are air operated.

D413
PACKAGED SEWAGE TREATMENT PLANT,

Surveyor, Vol. 151, No. 4474, p 27, March, 1978.

G. F. Dickson Environmental Engineering Ltd. of Guilford, Surrey, England, has developed the Biospiral immersed rotating disc biological filtration system suitable for populations of 10-800. The compact unit contains an archimedian screw biological filter and a drum filter for suspended solids removal. The

Biospiral system continuously recycles sludge and liquor to produce an effluent with 20/30 BOD and suspended solids concentrations. The patented tertiary treatment system employing a cloth filter is automatically cleaned when solids accumulate, eliminating the need for clarification of the effluent. Filter cleaning pumps transport the solids removed from the filter cloth surface to the system inlet or sludge storage tanks. The Biospiral units may be installed in series as part of a larger treatment system. The unit can accommodate fluctuating loads and has low operating and maintenance requirements.

D414

A CHLOROFORM PROBLEM AT GREAT WARFORD AND ITS SOLUTION,

Lumb, C., Brown, D., and Bottomley, M. K. V.

Allott and Lomax,
Manchester, England.

Water Pollution Control, Vol. 76, No. 11, p 459-467, 1977. 3 fig, 6 ref.

Air-stripping of sewage sludge was employed at the 2,950 cu m/day Great Warford municipal sewage treatment plant in England to remove chloroform originating from pharmaceutical plant wastes. Concentrations of chloroform averaged 2.7 mg/liter in wet sludge and 47 mg/kg in the dry sludge, arising from a discharge of 3 liters/day chloroform from the pharmaceutical laboratory. To improve sludge digestion, inhibited by the presence of chloroform, it was necessary to limit the concentration of chloroform in the dry sludge to 5-10 mg/kg. Laboratory experiments on air-stripping of chloroform indicated that an aeration intensity of 20 cu m/sq m/hr at 9 C for periods of 6.8-8.7 hr would reduce the wet sludge chloroform content of 0.2 mg/liter, yielding a dry sludge concentration of 5 mg/kg with a 4% dry solids content. The final sludge stripping system employed 15 coarse bubble air jet diffusers, with 600 jets mounted in the base of a 4.2 sq m tank operated on a batch basis. The stripped sludge was transported to a digester feed tank for chloroform monitoring before it was fed to the digester. Stripped sludges with chloroform concentrations in excess of 0.3 mg/liter, which would contribute to a dry sludge content of 7.5 mg/kg, were returned to the air-stripping unit.

D415

FOR THE SAKE OF A FOOTPATH 240,000 (POUNDS STERLING) WAS LOST,

Water Services, Vol. 81, No. 975, p 295-298, May, 1977.

Because of unstable ground conditions, the municipal waste water treatment facility in Saffron Walden, Essex, England, was constructed on piled foundations. The 5,160 cu m/day capacity plant required 670 piles at 29-30 m in length for support in the peat and alluvial soil; excavation was restricted to 4 m because of groundwater levels. The treatment system includes screening and degritting, primary settlement, biological filtration, secondary settlement, and effluent polishing with microstrainers. In the winter, BOD and suspended solids levels are reduced to 20 mg/liter and 30 mg/liter, respectively, and to 15 mg/liter and 20 mg/liter, respectively, during the summer when rivers have low flows. The sludge is thickened and stored for final treatment at a regional facility. Storm water is stored in tanks with a total capacity of 900 cu m and released for full treatment when flows decrease. During overflow conditions, the storm water flows over grassland for filtering and oxidation. Up to 100 mg/liter suspended solids are permitted in storm water discharged to the River Slade. The sewage flows by gravity to the site of the old treatment works from which it is pumped to the new plant.

D416

LIQUID ALUM IS SUCCESSFUL IN ORLANDO, FLA.,

Water and Wastes Engineering, Vol. 15, No. 4, p 54, April, 1978.

Orlando, Florida's, Bennett Road waste treatment plant removes 90% of the BOD and suspended solids from 10 mgd of waste water with liquid alum treatment. The trickling filter facility has a design capacity of 8 mgd; an average of 150-200 ppm of liquid alum is added to the waste water just prior to secondary clarification. The plant stores the 2.5-3 weekly truckloads of alum delivered in two 7,000 gal tanks; one tank holds a three-day reserve. During daily periods of high waste water flow, alum is added to the splitter box effluent after trickling filtration to provide additional flocculation time. Polymers are added before the secondary clarifier to assist in coagulation. The effluent BOD and suspended solids concentrations, after alum treatment, are 13 and 20 ppm, respectively. Effluent samples are analyzed every 2 hrs. A 24 mgd advanced treatment facility planned for Orlando will also be designed to incorporate the liquid alum treatment.

D417

SIERRAS BOAST MOST MODERN TREATMENT PLANT,

Allen, A. W.

Western Construction, Vol. 53, No. 4, p 22-24, April, 1978.

A $20 million tertiary treatment plant in California will treat 4.85 mgd of wastes from the Lake Tahoe Basin area, Truckee, and several other areas. The effluent receives conventional secondary treatment by primary and secondary settling with oxidation. Phosphorus and some suspended solids are then precipitated with lime, followed by polymer dosage in rapid-mix and flocculation tanks. The effluent is then injected with carbon dioxide gas in recarbonation basins for calcium removal and pH adjustment. The treated effluent is pumped to two ballast tanks with a total volume of 1.2 million gallons before the wastes are filtered, adsorbed on activated carbon towers, and stripped of ammonia on ion exchange beds and three ammonia removal and recovery modules for ammonium sulfate fertilizer production. The effluent is discharged into a series of subsurface ditches for percolation through the glacial soil into the Truckee River. Sludge is thickened, dewatered, conditioned with lime and polymers, filtered on a horizontal press operated by 3 variable speed pumps, and disposed of in a landfill. Carbon dioxide is generated on-site by compressed gas from the digester boilers and by carbon dioxide stripping during oxygenation of the wastes; supplementary liquid carbon dioxide is stored on-site. Oxygen is also generated on-side by Union Carbide's Pressure-Swing Adsorption process. The plant design includes enclosed piping and electrical corridors which provide passage from one building to another and a complete laboratory.

D418

INNOVATIVE DESIGN SLATED FOR TEXAS TOWN,

Garland, S. B., and Werner, D. F.

Bovay Engineers, Incorporated,
Houston, Texas.

Water and Wastes Engineering, Vol. 15, No. 3, p 32, 34, 38, March, 1978. 3 fig, 1 tab.

A 2.45 mgd contact stabilization plant operating in conjunction with an existing 0.85 mgd plant was designed for Lake Jackson, Texas, to accommodate peak flows up to 16.5 mgd. Primary treatment consists of screening and grit removal with Dyneco's Aqua-Guard, employing bar screen openings of 0.25 inches. An equalization/surge basin was selected for storing the peak storm water flows and for on-line control of diurnal fluctuations. Overflows in the two-section 700,000 gal equalization basin pass over a weir into the storage basin where the waste water is used as makeup when the peak flow subsides. The two-channel configuration provides a backup system when one channel is under repair and reduces the energy required for mixing waste water in a 700,000 gal tank. Pentech jet aerators at a depth of 22 ft were selected for the contact, equalization, and stabilization tanks, and for the aerobic digesters because of their lower power requirements. The aerators are guaranteed to maintain a dissolved oxygen concentration above 2 mg/liter and a tank bottom velocity of 1 ft/sec. The Leopold Clair-Vac floating siphon sludge collector accommodated the design specifications for size, shape, operation, and maintenance. Sludge is aerobically digested, gravity thickened, and dewatered by a belt filter press; scum is transported by an air lift pump to the filter press. Before discharge, the treated effluent is chlorinated for a contact period of 20 min with a Pentech jet disinfection system.

D419
INTERNATIONAL CONTRACTOR AND SUPPLIER FEATURES SLUDGE TECHNOLOGY,

Water Services, Vol. 81, No. 975, p 293-294, May, 1977.

Waste water treatment equipment manufactured by Hawker Siddeley Water Engineering Ltd., Workingham, Berkshire, England, and its subsidiary, F. W. Brackett, is reviewed. Trummer tube screw pumps lift influent at the treatment plant inlet; raked inlet screens, dewatering presses, Temact screenings presses, automatic baggers, and a TC incinerator remove and dispose of screenings. Spiral flow aerated grit channels with sedimentation and storm tank scrapers are available in an aluminum alloy or steel. Hawker manufactures diffused activated sludge systems that provide optimum oxygen transfer with low operating costs in sizes accommodating populations of 250-3,000,000. Brackett supplies Geiger vertical shaft surface aerators, Trummer tube screw pumps for sludge return, and final clarification tanks. Sludge and screenings disposal systems include thermal or chemical sludge conditioning in conjunction with a single rotating hearth, multipal hearth units, and Ahlstorm fluidized bed incinerators. AKA dissolved air flotation units thicken sludges in activated sludge processes. Tertiary treatment systems include the Brackett Microscreen and the Hawker Contraflow filter systems. These companies also manufacture industrial waste and potable water treatment equipment.

D420
ACTIVATED-CARBON TREATMENT REDUCES CHLORINE DERIVATIVES,

Water and Wastes Engineering, Vol. 15, No. 4, p 55, April, 1978. 1 fig.

A two-stage activated carbon system has been developed for the removal of chlorinated compounds from treated effluent. Designed by Caltech/JPL and NASA in cooperation with Orange County, California, the system incorporates activated carbon treatment prior to chlorination to remove potentially hazardous, compounds such as phenols, aliphatic amines, aromatic amines, and polychlorinated biphenyls. The second stage removes chlorinated compounds on the activated carbon after chlorination. Residual chlorine is also removed by the final activated carbon treatment. The combined chlorination-activated carbon treatment system has been shown effective in removing ammonia, which is converted to chloramines during chlorination and removed by subsequent activated carbon treatment.

D421
MARINE SLUDGE DISPOSAL,

Effluent and Water Treatment Journal, Vol. 18, No. 1, p 14, January, 1978.

Ocean dumping practices of sludge disposal used in England are reviewed. Land disposal of sludge was considered economically feasible where adequate land was available and agricultural aspects were conducive to land application. Sewage sludge has been disposed of in the North Sea, the Firth of Clyde, and Liverpool Bay at sites that were investigated over long periods. The New York

Bight was cited as an example of ocean disposal which proved detrimental to the marine ecology. Sludge disposal in the New York Bight caused sludge blanketing over the ocean bed, created anaerobic zones, and altered the character of the aquatic organisms and plants in the area. Sludge disposal at other sites has reportedly enhanced the flora and fauna of an area by enriching the source of food without causing eutrophication. Further research by marine biologists, ecologists, and sewage treatment authorities is recommended.

D422
RANGE OF INCINERATORS,

Water Services, Vol. 81, No. 975, p 294, May, 1977. 1 fig.

The Nicholas Herreshoff multiple hearth furnace, developed by Neptune Nicholas Ltd. of Camberley, Surrey, England, incinerates sewage sludge at temperatures ranging from 760-870 C. The furnace is constructed of a vertical cylinder containing circular hearths; sludge is dried in the upper zone, combusted in the middle zone, and the resulting ash is cooled in the lower zone where combustion gas is also preheated. Rotary scrapers or rabble blades, operated by a vertical shaft with an external power source, move the sludge through the different levels. Sludge is dried in the upper zone at a temperature of 70 C while the outlet gases are about 425 C. Few odorous gases are generated by evaporation with this configuration; flyash gases require minimal scrubbing. Dried sludge with a solids content of 40-50% is ignited on the combustion hearth in the presence of an oxidizing atmosphere; the ash is cooled by the fresh air of combustion. The incinerator has a diameter of 8 m and is available with 4-12 levels. The system is automatically controlled and is capable of accommodating fats, skimmings, or screenings which are introduced above the combustion hearth.

D423
OCEAN BAN BUOYS SLUDGE PROCESSES,

Chemical Week, Vol. 122, No. 10, p 38, March, 1978.

The Carver-Greenfield sludge treatment process is being considered for the disposal of sludge by the Los Angeles/Orange County Metropolitan Area Commission. Other alternatives to ocean disposal of sludge, which has been banned by the Environmental Protection Agency, are: transporting sludge to the desert for drying and composting, mechanical dewatering and composting, mechanical dewatering, pyrolyzing, and ocean disposal in deeper trenches. The Carver-Greenfield process is capable of generating fuel; it requires 300 Btus to dewater 1 lb of liquid in sludge, compared to 1,600 Buts/lb of water required by an Organic Recycling recovery process. In the Carver-Greenfield process, sludge is dewatered to 20% solids content on a filter press or centrifuge and mixed with vegetable oil if the sludge will be used as a food supplement or with fuel oil if it is to be incinerated. The sludge with an oil-to-solids ratio of 10:1 undergoes evaporation in multiple-effect units and is separated into solids and oil by settling or centrifuging. More than 90% of the oil is recovered and the liquid fraction is returned to the treatment plant. A 100 ton/day Carver-Greenfield system will cost an estimated $4.5 million or $10.4 million with energy generation for producing electricity.

D424

STUDY INVESTIGATES FATE OF METALS IN LAND DISPOSAL,

Water and Wastes Engineering, Vol. 15, No. 3, p 14, March, 1978.

The movement of heavy metals, contained in secondary treated waste water applied to land, through soil was examined for 4 soil types. Samples of the soil types were enclosed in drainage lysimeters and dosed at a rate of 2.7 cm/wk over a 2-yr period with effluent bearing 1 ppm each of copper, zinc, cadmium, nickel, and lead. Land plots of two of the soil types were treated in the same manner and protected from rainfall. Bermuda grass grown in the lysimeters, soil at various depths, and water from the root zone were sampled periodically for heavy metal analysis. Results indicated that heavy metals accumulated within the top 12.5 cm and primarily at the surface. Bermuda grass uptake of the heavy metals was minimal; downward movement of the metal through the lysimeters was slow.

D425

ALUM ADDITION AIDS SLUDGE PROCESS IN PHOSPHORUS REMOVAL,

Water and Wastes Engineering, Vol. 15, No. 3, p 14, March, 1978.

Alum precipitation of phosphorus with lime additions to maintain alkalinity was evaluated in a plug flow, oxygen aerated, activated sludge reactor. Alum doses from 84-184 mg/liter were added during five steady-state operating periods to the co-current liquid oxygen contacting reactor. The food-to-microorganism ratio was maintained between 0.18-0.24 g BOD/g mixed liquor volatile suspended solids. BOD levels were reduced by 82-92% to 7.4-19 mg/liter; phosphorus in the effluent decreased by 54-86% to 1.05-3.26 mg/liter. Phosphorus was most efficiently removed at an alum-to-phosphorus mole ratio of 1.8:1, resulting in a residual phosphorus content of 1.05 mg/liter. When the reactor was operated on a step-feed method with a food-to-microorganism ratio of 0.23 g BOD/g mixed liquor suspended solids, BOD was reduced by 89%. Sludge oxygenation, followed by three-stage oxygen aeration, sequentially reduced mixed liquor suspended solids (MLSS) in each stage to 10,700 mg/liter, 7,060 mg/liter, 5,020 mg/liter, and 4,150 mg/liter. Step-feed operation produced an effluent before clarification containing an average of 6,500 mg MLSS/liter and required less oxygen than co-current contact operation.

D426

POLYACRYLAMIDES SHOWN TO BE EFFECTIVE FLOCCULANTS,

Water and Wastes Engineering, Vol. 15, No. 3, p 14, March, 1978.

Polymerized linear and branched polyacrylamides were compared as flocculating agents for removing suspended solids and organic materials from waste water. Linear and branched anionic polyacrylamides were polymerized and fractionated into portions having different molecular weights. The samples were hydrolyzed to several anionic levels and evaluated for flocculating properties and efficiencies. The linear polyacrylamides were more efficient at flocculation than the branched structures; the higher the molecular weight of either the branched or linear polyacrylamides, the better the flocculating efficiency. Optimum flocculation occurred when the polymers were hydrolyzed from 15-30% and the waste water had a pH lower than 6.5.

D427

INTERIM TREATMENT PLANT BUILDS SLUDGE CONCENTRATORS,

Water and Wastes Engineering, Vol. 15, No. 3, p 48, March, 1978.

Four gravity pressure sludge concentrators employing cationic polymeric conditioning have been installed at a 20 mgd interim waste water treatment plant in Independence, Missouri. The plant, providing municipal and industrial waste treatment until an 80 mgd facility is completed, contains an earthen aeration and sedimentation basin, an aerobic digester, and two sand filters. Treatment reduces the BOD from an initial 180-200 ppm to 5 ppm and suspended solids from 200-225 ppm to 2 ppm. The accumulation of sludge in the aerobic digester, where it was stored and chemically treated, led to the installation of sludge concentrators which increase the solids content of the sludge from 4% to 14.5%. After the sludge is thickened to the 4% solids level, it is conditioned with a cationic polymer and flash mixed. The sludge is further concentrated by gravity dewatering and pressure; the sludge cake is pumped to a truck for land application.

D428

DOE CONTRACTS FOR SLUDGE DEWATERING,

Product Finishing, Vol. 31, No. 5, p 53, May, 1978.

Biospiral waste water treatment systems, distributed by Sludge Dewatering Ltd., have been selected for installation in three areas in Wales with small populations. The system contains a rotating disc biological filter formed on the archimedian screw design; an automatic rotating drum removes suspended solids. Effluent qualities guaranteed by the Biospiral system are 20/30 BOD and suspended solids, respectively. The unit is especially suitable for warm climates. The installation of the units, designated by England's Department of the Environment, will be in areas with populations of 160, 200, and 500. The

Biospiral will treat raw waste in one area, laboratory and domestic wastes in another, and supplement an existing plant in the third area.

D429
A NEW PACKING MEDIUM FOR BIOLOGICAL PERCOLATING FILTERS,

Water Services, Vol. 82, No. 985, p 192-193, March, 1978.

An injection molded filtration medium for biological waste water treatment has been developed by Alcor International Ltd. of Crawley, Sussex, England. The geometrically-shaped Biofil medium has triangular faces delineated by serrated edges which promote random packing and filter bed stability for biological growth. Point loading in individual units is eliminated by the design of the Biofil which evenly distributes the bed load through a series of planes. The uniform Biofil particles enhance distribution of the waste load with even contact time; blockage by biological growth is alleviated by the design which allows solids to filter through. The filter volume is reduced and the removal efficiency increased by the Biofil because of its improved load/efficiency curve, leading to a cost savings. The medium's surface area is conducive to high-rate biooxidation and has performed as well as other plastic packing. Biofil is suitable for primary or secondary treatment, biological percolating filters, and roughing and polishing of effluent.

D430
SEWAGE PUMPING THE PREFAB WAY,

Surveyor, Vol. 151, No. 4478, p 20, 1978. 1 fig.

Sykes Pumps Ltd., of London, England, has begun manufacturing prefabricated Pumpex sewage pumping stations in three size ranges. The pumping stations are constructed of a leak-proof, fiberglass-coated polyester tank equipped with pumps, pipework, valves, ladder, and control systems. Manufactured in diameters of 1.1 m, 2 m, and 2.5 m, the Pumpex stations have rated capacities up to 1,000 gal/min. The prefabricated stations are available in heights of 2.2-5.2 m to accommodate design depths of the pumping mains; each Pumpex unit is equipped with a steel plate cast at its base for attaching pump volutes with instructions for removing the motor units. The station is bolted to a concrete base and connected to the inlet and discharge lines of the pumping main. The excavated area is backfilled and the system is connected to a power source. Stations may be supplied with platforms, allowing the addition of a wash basin, water heater, lighting, flush water hose, and electric radiator.

D431
RANDOM PLASTIC FILTER MEDIUM,

Effluent and Water Treatment Journal, Vol. 17, No. 12, p 659, December, 1977.

The Random FLOCOR plastic medium for percolating filters reportedly treats a biological load three times the capacity of a mineral filter medium of the same volume. The cylindrical FLOCOR medium is structurally capable of withstanding its own weight and preventing blockage by acccretion. Forced aeration is not required because of the open structure providing more than 95% void space. The FLOCOR medium has a comprehensive strength of 7,000 kg/cu m with a surface area of 240 sq m/cu m. The use of FLOCOR reduces the number or size of trickling filters and its light weight permits easy installation. Filters require simple foundations and bases and pre-fabricated walls. Percolating filter heights up to 4-5 m can be accommodated when FLOCOR is utilized.

D432
BLANFORD AREA MAIN DRAINAGE SCHEME,

Water Services, Vol. 82, No. 983, p 59-60, January, 1978.

Thirteen miles of sewers and rising mains were constructed in the Blandford area in England to connect a 6.8-mile area of scattered villages to the Tarrant Crawford sewage treatment plant. Asbestos cement, and in some cases spun iron, sewer pipes ranging in diameter from 6-24 inches were installed under adverse groundwater and rainfall conditions requiring pumping at 6,000 gal/min in the excavation areas. The treatment works, with provisions for accommodating a population of 40,000, treats 619,987 gal/day of municipal wastes and 84,780 gal/day of industrial wastes to 30 mg/liter suspended solids and 20 mg/liter BOD. Flows exceeding 3 dry weather flows are treated to 150 mg/liter suspended solids. Peak flows are stored for 3 hrs in three 365 cu m storm water tanks and pumped to the treatment plant when the flow subsides. Influent is screened by mechanically raked curve bar screens, and passed through a Pista grit trap. Sewage passing to the activated sludge feed and aeration chamber is automatically controlled by a storm water penstock and a flume control measure. The activated sludge is aerated and thoroughly mixed by a horizontally rotating Passavant Mammoth Rotor. Dissolved oxygen is automatically maintained by a sensor activated motorized effluent weir which controls submergence of the rotor. Effluent passes into three 13.7-m diameter final settling tanks where activated sludge is hydrostatically removed and liquid is discharged to a river. Activated sludge is returned by screw pumps to the system and the excess is thickened in a 7.6 m diameter tank equipped with a picket fence stirrer and stored for disposal.

D433
U-TUBE CONNECTIONS FOR WASTEWATER PONDS,

Churchwell, R., and Fox, A.

Tenneco Chemicals,
Pasadena, Texas.

Chemical Engineering, Vol. 85, No. 11, p 212, May, 1978. 3 fig.

A U-shaped tube for returning floating solids from a holding pond to a skimmer-equipped pond is readily adjustable to varying heights. The ends of the U-tube pipe apparatus are equipped with angle irons located at 120 degree intervals around the pipe's circumference. The angle irons support additional pipe rings for increasing the height of the U-tube. Surface scum and floating materials are transferred from the feed pond to the skimmer pond by adjusting the height of the U-tube with the pipe rings to the required level in the feed pond. The back-bevelled pipe rings, which are hung on the angle irons when not in use, are easily assembled and alleviate leakage. Gravity flow through the U-tube can be sustained in either direction.

D434
WASTEWATER TREATMENT FACILITY,

Consulting Engineer, Vol. 50, No. 5, p 96, May, 1978.

A regional waste water treatment facility, designed by the engineering firm of Foth and Van Dyke and Associates, Inc. of Green Bay, Wisconsin, replaces two treatment plants and a number of septic systems in four Wisconsin towns. The regional facility maintains two activated sludge plants for secondary treatment of the effluent from the four towns. Tertiary treatment is provided by a 20-acre glacial deposit infiltration-percolation system. Effluent is passed to three seepage lagoons equipped with a surrounding underdrain system. The waste water is filtered prior to groundwater recharge or river disposal. Little maintenance is required for the natural soil ponds which saved an estimated $350,000 over a 20-yr period. The regional waste water treatment facility reduced the pollutant load on a trout stream in the area.

D435
BLANFORD AREA MAIN DRAINAGE SCHEME,

Effluent and Water Treatment Journal, Vol. 18, No. 1, p 37, January, 1978.

The Blanford, England, sewage treatment project includes 13 miles of sewers and rising mains and a municipal waste treatment facility with an ultimate design capacity of 40,000 population equivalents. High water tables necessitated pumping of the excavation areas during installation of the asbestos cement and spun iron sewers and rising mains with diameters ranging from 6-24 inches. The Tarrant Crawford sewage treatment plant reduces BOD and suspended solids to 20 mg/liter and 30 mg/liter, respectively, under normal conditions; flows in excess of this are treated to 150 mg/liter suspended solids. Mechanically raked curve bar screens and a Pista grit trap screen the influent which is then treated by the activated sludge process in aeration chambers equipped with horizontally rotating Passavant Mammoth Rotors. Submergence of the rotor to maintain dissolved oxygen levels is controlled by a motorized effluent weir activated by an oxygen sensor. Three 13.7 m diameter settling tanks contain hydrostatic equipment for activated sludge removal. Liquid is removed from the tanks for discharge to a river; activated sludge is returned to the system; and excess sludge is pumped to thickening tanks followed by storage for discharge. Storm water is stored in 3 tanks with 365 cu m capacities for discharge to the treatment plant.

D436
SAVE IT AERATION,

Effluent and Water Treatment Journal, Vol. 18, No. 4, p 197, April, 1978.

The Mixaerator was designed on the basis of a 72% oxygen transfer by a 3 mm bubble at 60 cm depth; it provides zero diffuser head loss and thorough mixing during aerobic digestion. The Mixaerator is constructed of a resin-bonded fiberglass casing with a polypropylene air pipe and manifold and horizontal diffusers. Air is discharged through 100 perforations of 4-7 mm in diameter in the diffuser head. The airlift action exerted by the bubbles and water on the intake, at the base of the aerater, accelerates intake at a perpendicular angle to the diffuser, causing shearing of the bubbles to prevent bacterial growth on the aerators. The unit discharges a horizontal surface stream at 177 cu m/hr generated by blowers or centrifugal fans exerting pressures of 1 psi. Large systems with 23 Mixaerator units have maintained oxygenation efficiencies of 2.6 kg oxygen/kilowatt-hr.

D437
BUBBLE POWER CUTS SEWAGE PLANT ENERGY USE,

Engineering News-Record, Vol. 200, No. 17, p 16, April, 1978.

Polyethylene biological contact cylinders, installed in Philadelphia, Pennsylvania's Northeast waste water treatment plant, may receive additional government funding as an innovative design. The 190 mgd treatment plant installed 22 surfact units, each 25 ft long with a 12 ft diameter, providing a total of 2.2 million sq ft of surface area. The honeycombed cylinders contain angled cups which catch the air from the aeration bays, causing the cylinders to rotate at about 0.8 rpm without a power source. An estimated $850,000/year will be saved in power costs with the biological treatment system, which also reportedly increases the activated sludge process efficiency. The surfact system is expected to provide an additional 28% of the costs of upgrading the secondary treatment plant to 250 mgd. The city may receive an additional 10%

funding for the $160 million project as an incentive for designing innovative sewage treatment techniques.

D438
TWO BELT FILTER PRESS PROVIDES LOW COST DEWATERING,

Modern Power and Engineering, Vol. 72, No. 3, p 35, March, 1978.

The Perrin model FBP continuous belt filter press provides two separate screens to accommodate varying porosity specifications. The continuous screen belts are independently washed and available in widths of 2-10 ft. The filter press utilizes different screen sizes for supplying high and low pressure operation. The screen belts are constructed with an automatic tracking apparatus and with varying porosities to meet specific dewatering needs. Frictional wear on the belts is reduced in the Perrin press by its single converging screens and simple sludge circuits. Drainage and pressing operations are reportedly more efficient because the screens are individually washed, providing double processing of sludge on clean screens. Perrin manufactures seven models of the continuous belt filter press, producing dewatered sludge with solids contents of 15-40%.

D439
EVALUATION OF A WATER-REUSE CONCEPT FOR HIGHWAY REST AREAS,

Parker, C. E., Ritz, M. A., Heitman, R. H., and Kitchen, J. D.

Transportation Research Record, No. 631, p 37-39, 1977. 1 fig, 1 tab, 2 ref.

A waste water reuse system was developed for highway rest areas where waste water disposal processes and potable water supplies are often limited. The reuse system, suitable for areas equipped with extended aeration biological treatment, requires additional sedimentation and sand filtration. Water used in flushing toilets, representing 90-95% of the total water use, undergoes extended aeration followed by sand filtration and chlorination. Between 90-95% of the treated flushing water can be recycled to the toilets with 5-10% of the drinking fountain and lavatory waste water added as makeup. When 95% of the flushing water was recycled with sodium fluorescein and blue dye added for color, the returned water contained 12 mg/liter BOD, 846 mg/liter COD, and 7,152 mg/liter total dissolved solids. It was suggested that recycled water be maintained at pH 8.3 during the winter and pH 5.5-6.0 in the summer to control nitrification.

D440

REDUCING COLIFORM AND SALMONELLA BACTERIA DURING ANAEROBIC DIGESTION,

Cooke, M. B., Thackston, E. L., and Malaney, G. W.

Vanderbilt University,
Nashville, Tennessee,
Department of Environmental Engineering and Policy Management.

Water and Sewage Works, Vol. 125, No. 1, p 50-53, January, 1978. 4 fig, 2 tab.

The reduction of salmonellae and coliforms by anaerobic digestion was examined in three sewage treatment plants in Tennessee. Samples of primary-treated and anaerobically-digested sludge were collected from each plant over three days and analyzed by the multiple tube fermentation technique for coliforms and by the Alley-Malaney membrane filter technique for salmonellae. Similar coliform concentrations before digestion were apparent in raw sludge from all three plants; anaerobic digestion at the two Murfreesboro treatment plants reduced coliforms by 10,000-fold on the third sampling day, while significantly lower reductions were observed in Nashville's Dry Creek plant. Salmonellae concentrations in undigested sludge were similar in the three plants on the first two sampling days. In samples of digested sludge taken during these days, the two Murfreesboro plants reduced salmonellae concentrations by 1,000-10,000-fold, while concentrations were reduced 100-fold by the Dry Creek plant. The greater reductions at the Murfreesboro plants were attributed to detention times of 50 and 38 days; Dry Creek detention time averaged 9 days.

D441

SOME TESTS ON THE MEMBRANE FILTER PLATE,

Edmondson, B. R., and Brooks, D. R.

Severn-Trent Water Authority,
Birmingham, England.

Water Pollution Control, Vol. 77, No. 1, p 117-137, 1978. 8 fig, 13 tab.

A full-scale membrane filter plate press, equipped with two inflatable cloth membrane plates, was tested with sludge from five treatment facilities to evaluate the increased solids output potential of membrane filter plates over conventional recess plate presses. Under manual operation, the membrane filter plate, producing a 35% dry solids sludge cake that was 32 mm thick, increased the ouput of three of the treatment plants by 69%, 64%, and 24% for a 24-hr, 5-day/week operation. Automatic operation of the membrane filter plate increased output by 129%, 141%, and 68%. The membrane filter plate reduced the press cycle to 45 min for easily dewatered sludges and controlled the dry solids content by the squeeze time. The membrane filter plate was more adaptable to automation, significantly increasing the output of solids.

D442
INSURING TROUBLE-FREE PUMP OPERATION,

LaFarge, A.

Water and Sewage Works, Vol. 125, No. 5, p 60-63, May, 1978. 6 fig.

Recommendations are reviewed for improving the installation and operation of pumps used in waste water treatment facilities. Flooding of pumps installed in low-lying areas requires cleaning and greasing of the bearings, stuffing box, mechanical seals, couplings, impeller, and pipes. Location, foundation, alignment, and piping are considered in the installation of pumps. It is recommended that pumps be located near the inlet and below the liquid flow, especially when suction lift pumps are used, to facilitate priming and flow rate. Alignment of the pump by placement on a foundation of blocks and shims is important during installation to prevent uneven wear and ensure proper operation. Grouting around the steel or cast iron base plates stabilizes the alignment and compensates for an uneven foundation beneath the pump. Pipes should have air-tight joints and be installed in the most direct route to the pump. Suction and discharge pipes require supports or anchors to prevent stress. A length of suction pipe 4-5 times the pipe diameter should be installed upstream of the pump to maintain proper flow. Suggestions are made for proper pump maintenance.

D443
WASTEWATER TREATMENT PLANT IS REGIONAL SUCCESS,

Dobson, R. T.

Gwin, Dobson and Foreman, Incorporated,
Altoona, Pennsylvania.

Water and Wastes Engineering, Vol. 15, No. 1, p 46-48, January, 1978. 1 fig, 2 tab.

A regional waste water treatment plant in Tyrone, Pennsylvania, treats 9.0 mgd of combined municipal and paper mill wastes. One-third of the design flow is generated by the Westvaco Corp. paper mill which provides primary treatment of its wastes; provisions have been made to expand the municipal treatment plant to 30 mgd. The waste water receives comminution, primary clarification, aeration and activated sludge treatment, followed by final clarification and chlorination. Paper mill sludges with a high clay content are mixed with sewage sludges, conditioned with polymers, thickened, centrifuged, incinerated in a fluidized bed reactor, and discharged to a landfill. Effluent during the initial phase of operation contained 15.6 mg/liter BOD and 19.8 mg/liter suspended solids. A 3,000-linear ft reinforced concrete interceptor sewer with a diameter of 48 inches and a capacity of 36 mgd was constructed to connect the new treatment facility to the site of the former treatment plant.

D444
PERFORMANCE EVALUATION OF EXISTING LAGOONS-PETERBOROUGH, NEW HAMPSHIRE,

Bowen, S. P.

JBF Scientific Corporation,
Wilmington, Massachusetts.

1977. 101 p, 6 fig, 6 tab, 2 append. Technical Report EPA-600/2-77-085.

The performance of waste water treatment lagoons in Peterborough, New Hampshire, was monitored over a 12-month period with respect to federal standards for effluent quality. The treatment plant had average and design flows of 0.5 mgd and 2.14 mgd, respectively; three treatment lagoons without aeration had a total surface area of 21 acres. Chlorination of the treated effluent was conducted before discharge. Fecal coliforms and suspended solids were efficiently removed during the entire study; BOD and COD were adequately reduced during all but four months of the study. During these winter months, total BOD was reduced by 60% to about 52 mg/liter and pH dropped to below 6.0. The reduced efficiency of the treatment lagoons was attributed to anaerobic conditions created by an ice cover. The installation of induced air aeration equipment in one or more ponds was recommended. A 27% seepage loss was recorded in the plant which was BOD and hydraulically underloaded. Average effluent dissolved oxygen levels of 2 mg/liter dropped to zero during the winter months; ammonia-nitrogen concentrations increased and nitrate-nitrogen decreased during the cold periods. Total phosphorus was reduced by about 10% for the year; nitrate-nitrogen was removed to below detectable levels. Alkalinity doubled during the winter months because of the necessary increase in residual chlorine levels from 2 mg/liter to 40-50 mg/liter.

D445
DOWNFLOW GRANULAR FILTRATION OF ACTIVATED SLUDGE EFFLUENTS,

Bowker, R. P. G.

Government of the District of Columbia,
Department of Environmental Services,
EPA-DC Pilot Plant,
Washington, District of Columbia.

1977. 55 p, 16 fig, 6 tab, 6 ref, 1 append. Technical Report EPA-660/2-77-144.

The impact of downflow granular filtration media properties on activated sludge effluents from plug flow, complete mixing, and step aeration operations was evaluated in pilot plant studies. The filtration media consisted of anthracite in particle sizes ranging 1.0-2.0 mm, with or without sand with effective particle sizes of 0.4-0.9 mm. The media depth in the filter was varied over 38-64 cm for the anthracite and 30-38 cm for sand. Hydraulic loadings on 0.1 sq m filters were varied over 3-9 gpm/sq ft. Breakthrough of suspended solids in the activated sludge treated waste water occurred during tests with single media anthracite with particle sizes of 1.65 and 2.0 mm. Breakthrough was observed to increase at higher flow rates. With a dual media of 2.0 mm anthracite and 0.9 mm sand, higher quality effluent was obtained with higher suspended solids loadings and longer run times. Backwashing tests of the dual filter media demonstrated that a 13% bed fluidization at a 35 gpm/sq ft flow rate was effective in cleaning. The growth of filamentous organisms and Nordica species interfered with some of the experiments, as did low suspended solids concentrations in some of the activated sludge influent.

D446

WASTEWATER DEMINERALIZATION BY TWO-STAGE FIXED-BED ION EXCHANGE PROCESS,

Chen, C-L., and Miele, R. P.

County Sanitation Districts of Los Angeles County,
Whittier, California.

1977. 81 p, 19 fig, 27 tab, 4 ref. Technical Report EPA-600/2-77-146.

A 2.5 gpm two-stage and an automated 4 gpm single-staged fixed ion exchange pilot plant were used to investigate the impact of carbon adsorption pretreatment of waste water on ion exchange performance. The 2.5 gpm pilot plant, located in the sewage treatment plant at Pomona, California, contained primary cation, primary anion, secondary cation, and secondary anion exchange columns, operated in series. Regenerants were first applied to the secondary exchange columns and then to the primary columns in a downflow direction to insure monovalent ion removal efficiency from the secondary columns. Resin longevity studies were conducted with the 4 gpm single-stage pilot plant over 32 mos. Resins remained stable throughout the tests. The two-stage plant reduced total dissolved solids by 90% at regenerant concentrations of 17.6 gal/liter H_2SO_4 in the cation column with 85% regeneration efficiency and 9.6 gal/liter NH_3 in the anion exchanger with 90% regeneration efficiency. Costs associated with reducing total dissolved solids from 600 to 60 mg/liter in a 10 mgd operation were $0.059/1,000 liters.

D447

FEASIBILITY OF TREATING SEPTIC TANK WASTE BY ACTIVATED SLUDGE,

Bennett, S. M., Heidman, J. A., and Kreissl, J. F.

Government of the Districct of Columbia,
Department of Environmental Services,
EPA-DC Pilot Plant,
Washington, District of Columbia.

1977. 67 p, 17 fig, 12 tab, 10 ref. Technical Report EPA-600/2-77-141.

Pilot plant studies evaluated the impact of septic tank wastes on municipal activated sludge treatment facilities. Septic tank pumpings, generated at an estimated volume of 13 million cu m/yr, were introduced into a 1,980 gpd activated sludge pilot plant on a continuous flow basis and on a shock load basis. Batch aeration tests were also conducted for the shock load studies. A control unit treating only primary effluent was also operated over the four month study period. The municipal activated sludge pilot plant was able to accommodate both continuous and intermittent loads of septic tank wastes without significant interference with effluent quality. While the strength and organic loading of the septic wastes introduced on a continuous feed basis influenced the response of the activated sludge system, wastes with COD levels below 3 g/g mixed liquor volatile suspended solids/day did not disrupt treatment performance. Unacclimated activated sludge systems were also able to accommodate septage. Results of the study also indicate that sufficient excess aeration, especially for shock septage loads, and adequate sludge handling facilities are necessary for municipal activated sludge treatment of septic wastes.

D448

CENTRAL PIVOT SPRAY SYSTEM CONTROLS STORM LAKE POLLUTION,

Rosse, J. C.

Water and Sewage Works, Vol. 125, No. 1, p 72-75, January, 1978. 2 tab.

A system of lagoon treatment, storage, and central pivot spray irrigation has been installed to treat a combined municipal and industrial food processing waste flow in Storm Lake, Iowa. The waste water, containing high concentrations of ammonia-nitrogen and sulfate, is treated in two waste water plants and/or diverted to the lagoons which provide biological treatment, stabilization, anaerobic and aerobic treatment, and storage. The stored waste water is used to spray irrigate leased cropland; a 630-ft Model 2071 Valley electric drive center pivot system with five drive towers irrigates a 33-acre circle. Pilot plant studies on a 40-acre tract planted with corn and soybeans indicated that application of 8.2 inches of effluent to a corn crop during the growing season increased the yield by 30%; 18.7 inches applied to a soybean crop increased the yield by up to 100%. Groundwater studies have indicated that waste water applications up to 18.7 inches/yr would not adversely affect groundwater, dependent upon annual precipitation. Waste water is stored during the winter months when ammonia-nitrogen levels are the highest to prevent fishkill in the receiving streams.

D449
HOME REMEDY HELPS FIGHT SLUDGE BULKING,

Barber, N.

Water and Sewage Works, Vol. 125, No. 4, p 45-46, April, 1978. 2 fig, 1 tab.

Sodium bicarbonate treatment of waste water bearing large volumes of high pH, starchy industrial wastes has improved sludge settleability in the Wilbraham, Massachusetts, municipal waste water treatment facility. The treatment plant has fluctuating volume and organic loads which range 30,000-130,000 gpd and 1500-2500 ppm BOD. The higher flow rates and BOD occur during the week when a potato chip plant and an ice cream plant are in operation. Waste water laden with starch and having a pH up to 12.2 flows to the plant once each week when the potato chip plant's tanks are washed. A 300 lb dose of sodium bicarbonate is added to the aeration tanks, followed by subsequent additions of 50 lb/day on Monday through Wednesday and 100 lb/day on Thursday and Friday. Aerated waste water is settled and chlorinated before discharge with 30 ppm BOD and suspended solids. The sludge volume index was decreased to 80-90, alkalinity was increased from 285-344 mg/liter and sludge solids content was increased by 1.5-2.5% with sodium bicarbonate treatment. Waste sludge volume decreased from 14,000-9,000 gpd and mixed liquor suspended solids increased from 6,460-11,600 ppm within 6 mos.

D450
NEW HAMPSHIRE SECTION NAMES TREATMENT FACILITY STATE'S OUTSTANDING CE ACHIEVEMENT,

Lally, B. M.

Civil Engineering-ASCE, Vol. 48, No. 2, p 84-85, February, 1978.

The New Hampshire division of the American Society of Civil Engineers has cited the Manchester, New Hampshire, 26 mgd waste water treatment plant as a significant engineering achievement. The waste water treatment project provides for the construction of 20 miles of interceptor sewers, a pumping plant, and expansion of the facility to 60 mgd. The treatment facility, which will reduce the pollution load on the Merrimack River, provides secondary waste water treatment with 2 primary and 2 secondary clarifiers, aeration basins, chlorination, sludge thickening, and sludge incineration. Venturi scrubbers mounted in the incinerators reduce the particulate emissions into the air. The treatment system is electrically monitored and remotely controlled; gas analyzers and negative room pressure equipment have been installed in potentially hazardous areas of the plant. Air exhausted from these areas by negative pressure is treated with ozone for deodorizing the gases before release. Air in areas containing toxic or explosive supplies is exchanged 12 times/hr.

D451

EFFLUENT TREATMENT PROCESS USES FILAMENT-WOUND GLASS FIBER/EPOXY,

Reinforced Plastics, Vol. 22, No. 2, p 52-53, February, 1978.

Glass-reinforced plastic was selected as piping material for the installation of a deep shaft effluent treatment system at the Marsh Farm Sewage Works in Tilbury, Essex, England. Because the combined municipal and industrial waste water treated at the plant had a high chloride level, the deep shaft equipment had to be resistant to corrosion for a period of 30 yrs. The 132-m long filament-wound fiberglass epoxy downcomer, with a 1,200 mm diameter, hangs freely in a 130-m deep shaft with a 2-m diameter. The fiberglass epoxy pipe was delivered in 10-m sections and joined with a locking system and resin injection to insure tensile strength and rigidity. Effluent is passed through a bell-mouthed T-piece to the downcomer, equipped with stainless steel aeration pipes. The fiberglass-reinforced plastic pipes are manufactured by Wavin Plastics Ltd. of Hayes, Middlesex, England.

D452

ALUM USED FOR REMOVING PHOSPHORUS FROM WASTEWATER,

Water and Wastes Engineering, Vol. 15, No. 4, p 67, April, 1978.

Alum conditioning of waste water has been instituted at the 900,000 gpd activated sludge treatment facility in Trenton, Ontario, Canada. The waste water has an average pH of 7.2 and contains 200 mg/liter BOD and 3.0 mg/liter phosphorus. Alum treatment methods investigated included continuous 55 mg/liter additions, continuous 14.3 mg/liter additions, 12 hr 30 mg/liter additions, 24 hr cyclic 20 mg/liter additions, and no chemical additions. The 14 mg/liter continuous alum treatment after aeration of the wastes reduced phosphorus concentrations to 0.6 mg/liter and alum requirements by 57%. The theoretical ratio of 1 mole Al:1 mole P has been reduced due to the phosphorus removal by alum sludge return to the system. Higher amounts of phosphorus were removed with lesser amounts of alum, possibly because of phosphate binding by the alum sludge. Jar tests of alum removal of phosphorus overestimated the alum dosage required by 500%.

D453
PERFORMANCE, DESIGN AND OPERATION OF NORTHERN EXTENDED AERATION PLANTS,

Given, P. W., and Smith, D. W.

Northern Technology Center,
Fisheries and Environment Canada,
Edmonton, Alberta, Canada.

Canadian Journal of Civil Engineering, Vol. 5, No. 1, p 70-82, March, 1978. 12 fig, 2 tab, 19 ref.

The performance of extended aeration treatment plants in northern Canadian territories and Alaska with mean temperatures below freezing was compared in a literature review with the performance of plants located south of the 0 C mean annual isotherm and National Sanitation Foundation (NSF) plants. The northern plants were found to have stronger sewage than the non-northern plants with influent BOD and COD concentrations averaging 289 mg/liter and 722 mg/liter, respectively, in the northern regions and 156 mg/liter and 405 mg/liter, respectively, in the non-northern regions. BOD was reduced by 56%, COD by 51%, and suspended solids by 58% in the northern plants; the non-northern plants reduced BOD by 60%, COD by 47%, and suspended solids by 44%. Optimum removal rates established by NSF for BOD and suspended solids were 89% and 87%, respectively. Low performance standards in the northern treatment plants were attributed not to temperature but to hydraulic and organic overloading, failure to scrape the clarifiers and maintain sludge returns, and insufficient aeration.

D454
WAUSAU SOLVES DUAL PROBLEM BY USING FILTER PRESS,

Bizjak, G. J., and Becher, A. E., Jr.

Becher-Hoppe Engineers, Incorporated,
Schofield, Wisconsin.

Water and Wastes Engineering, Vol. 15, No. 2, p 28-20, 32, February, 1978. 2 fig, 1 tab.

A Zimpress cloth filter press installed in the Wausau, Wisconsin, waste water treatment plant dewaters combined waste water and water treatment sludges. Thickened water treatment sludges, comprising about one-third of the daily 16,209 lbs of combined sludge treated, are mixed with waste water sludges in an oxidized storage tank where they are further concentrated from the initial 4% or higher solids content. The sludge flows by gravity to one of two ram-type filter press feed pumps with hydraulic capacities of 125 gpm at 100 lbs/sq inch. The flow-controlled, pressure-compensating filter press is floor mounted and contains cast iron plates controlled by an automatic mechanism. The press has a polypropylene-monofilament yarn filter with a surface area of 1,381.8 sq ft; under continuous operation, the press has a cycle time of

2.25 hrs. A filter cake with a total solids content of 45% is produced; the press frame allows for future expansion by 40%. Filtrate is returned to the aeration tanks and the sludge cake is disposed of in a landfill. The solids dewatering system cost a total of $429,678.

D455
RADIATION TREATMENT OF WASTE WATER,

Ballantine, D. S.

Division of Biomedical and Environmental Research,
United States Energy Research and Development Administration,
Washington, District of Columbia.

Water Pollution Control, Vol. 77, No. 1, p 87-96, 1978. 8 fig, 3 tab, 35 ref.

Design criteria for radiation treatment of waste water are reviewed and two sewage irradiation systems are described. Radiation has been found to: reduce the BOD and COD concentrations in sewage; improve biodegradation; destroy cyanide and chlorinated organic pesticides; enhance settling, filtering, and dewatering properties of sludge; and disinfect pathogenic sewage bacteria. Electron accelerators and gamma radiation with cobalt-60 or cesium-137 are cited as the primary sources of radiation. Cesium-137 has the disadvantages of being less available, producing less kilowatts/curie, and diminishing by 50% through self-adsorption. Marketing of cobalt-60 is more extensive, but with increased use of nuclear power, cesium-137 will be more readily available. The Geisselbulach, West Germany, sewage treatment plant utilizes cobalt-60 to irradiate municipal sludge for disinfection before land application; the system includes an irradiation shaft equipped with a reaction vessel and a recirculation system for complete exposure to the radiation. A 50 kilovolt electron accelerator utilized at the Dear Island Waste Treatment plant in Boston, Massachusetts, incorporates aeration and spreading of the sludge on a rotating drum which moves the sludge under the accelerator beam. Although the design sludge thickness is 2 mm, radiation from the electron accelerator penetrates to about 0.3 cm. A cost comparison of the three irradiation systems reported that a cobalt-60 source cost $0.89/kl, cesium-137 radiation cost $0.75/kl, and a 3-million volt electron accelerator cost $0.40/kl of sludge treated.

D456
TROUT SIGH WITH RELIEF AS PLANT ENDS POLLUTION,

Swanson, J. L.

Stearns and Wheeler,
Cazenovia, New York.

Water and Wastes Engineering, Vol. 15, No. 3, p 26-27, 31, March, 1978. 1 fig.

An 0.95 mgd waste water treatment plant constructed for Cazenovia, New York, reduced the pollution load on the Chittenango Creek, a feed stream to Oneida Lake. The plant was constructed with provisions for expansion to 2.1 mgd. Treatment is supplied by an oxidation ditch with horizontal rotary aerators requiring low maintenance and providing high oxygen transfer. After the influent is comminuted and aerated, it is flocculated in settling tanks. Sludge is returned by two pumps to the preaeration tank and liquid is contacted for 15 min with chlorine. Sludge is dried in three paved earthen beds. Nitrification is maintained at 50% during the summer months; BOD is reduced by 85%. Provisions for plant expansion include additional primary and secondary settling tanks, aeration splitter boxes for chemical conditioning mixers, clariflocculators, and aeration basins in series to provide two-stage nitrification. The existing treatment facility was constructed at a cost of $1,790,000.

D457
COMPUTER-CONTROLLED PLANT FEATURES ADVANCED TREATMENT,

Public Works, Vol. 109, No. 2, p 50-54, February, 1978. 2 tab.

A 12 mgd addition to an existing 4 mgd sewage treatment plant in the New Jersey township of Parsippany-Troy Hills was designed with computerized control. The plant addition includes: 2 grit chambers, 6 primary settling tanks, 6 diffused air aeration tanks with activated sludge, 6 final settling basins, and 2 chlorine contact tanks for sodium hypochlorite disinfection. A planned 18 mgd advanced waste water treatment addition will include: 4 nitrification tanks and clarifiers; 4 methanol reduction tanks, supplying about 9,100 lbs methanol/day; 4 denitrification tanks and clarifiers; and 8 multimedia filters, each with a 400 aq ft surface area. The 12 mgd addition will supplement the existing anaerobic digestion and vacuum filter dewatering of sludge with gravity thickening of primary sludge and air flotation of waste activated sludge. It will also incorporate chemical conditioning with lime, aluminum chloride, and polymers; vacuum filter dewatering; incineration in two multiple hearth furnaces; and ash storage in lagoons. Control of the plant is maintained by a Fischer and Porter computer-based real time system with a dual computer arrangement. The computer system controls 14 plant operations and monitors 9 others with magnetic flowmeters in the plant addition. The computer system controls flows to the primary settling tanks, to the aeration tanks, to the secondary settling basins, and activated sludge returned to the aeration basin. The quantity of waste activated sludge, the air flow in the diffused aeration tanks, the number of blowers on-line, primary sludge pumping, and sodium hypochlorite disinfection are also computer controlled.

D458

UNIQUE SLUDGE HANDLING SYSTEM CHOSEN IN DUBUQUE,

Walker, J. T.

Environmental Engineering Department,
Henningson, Durham, and Richardson,
Omaha, Nebraska.

Water and Wastes Engineering, Vol. 15, No. 2, p 20-23, February, 1978. 1 fig, 2 tab, 7 ref.

A sludge treatment system combining centrifugation, thermal conditioning, vacuum filtration, incineration, and landfill disposal of ash was selected for the Dubuque, Iowa, waste water treatment facility. The system was chosen over six alternatives employing centrifugation, anaerobic digestion, thermal conditioning, vacuum filtration, incineration, landfill disposal or land application of sludge. Secondary sludge is expected to have a 30% solids content after vacuum filtration and thermal conditioning. About 20% of the primary sludge will receive thermal conditioning and vacuum filtration followed by incineration. Although the dewatered secondary sludge will not require supplementary fuel for incineration, thermal conditioning will use 1.8 million BTU/hr of power. Waste heat operated boilers and coal-fired boilers are being considered as alternatives to gas-fired burners. Effluent is treated by the plant with aerated grease and grit removal, primary settlement, trickling filtration, oxygen activated sludge, final clarification, and chlorination. Primary sludge is vacuum filtered and incinerated in a fluidized bed. Secondary sludge is pumped to an aerated holding tank, centrifuged, thickened, thermally treated with primary sludge, vacuum filtered, and incinerated in a fluidized bed. The plant capacity will be 15 mgd by 1990.

D459

CHEMICAL FLOCCULABILITY OF SLUDGE ORGANISMS IN RESPONSE TO GROWTH CONDITIONS,

Wu, Y. C.

Pittsburgh University,
Pennsylvania,
Department of Civil and Environmental Engineering.

Biotechnology and Bioengineering, Vol. 20, No. 5, p 677-696, 1978. 10 fig, 4 tab, 19 ref.

The influence of nutrient deficient wastes on alum flocculation of sludge organisms was evaluated in an activated sludge system without cellular recycle. Microbial samples were cultivated in a continuous-flow activated sludge reactor at 25 C, using a hydraulic retention time of 4.5 hrs and an aeration rate of 2,000 ml/min/liter. Cell capsule formation occurred under phosphorus and nitrogen limitation; capsules were thought to be negatively-charged polymers when formed in neutral conditions. While the unit cell surface charge was not influenced by low nutrient restrictions, it increased significantly when COD:N and COD:P ratios increased above 34:1 and 290:1, respectively. This phenomenon was attributed to increased capsule material accumulation. Biological solids production, bacterial cell surface properties, and residual and soluble P content in the culture media were controlled by the influent feed concentrations of N and P; these conditions, in turn, directly affected the chemical flocculation efficiency of the system. Higher alum doses were required to flocculate nutrient-starved dispersed microorganisms because of the higher unit cell surface charge and resistance to charge neutralization. The ratio of alum-to-phosphorus for 90% phosphorus removal was higher than the stoichiometric relationship of these substances at equilibrium; an alum-to-phosphorus ratio of 1.17:1-2.0:1 was required to produce effluent soluble phosphorus concentrations of 6.68-9.03 mg/liter. Sludge settling velocity increased with increasing nutrient concentrations in the feed.

D460

CO-DISPOSAL OF SEWAGE SLUDGE USING REFUSE-DERIVED FUEL,

Kaufman, H. L., and Grillo, L. M.

Clifford Bogert Associates, Consulting Engineers,
Fort Lee, New Jersey.

Institute of Environmental Sciences, Technical Meeting, Proceedings, p 204-208, 1978. 4 ref.

Co-disposal of sewage sludge and refuse-derived fuel (RDF) is considered an economical means of recovering inherent energy in the waste products and reducing the need for fossil fuels. RDF from municipal solid wastes contains an estimated 6,500-7,000 BTU's/lb, compared to raw and digested sludges which have heat values of 12,000 and 10,000 BTU's/lb, respectively. RDF as a supplementary or primary fuel source costs less than fuel oil and low sulfur coals but produces more ash after incineration of sewage sludge. Thermal disposal of sewage sludge by dewatering and incineration may employ RDF as a supplementary fuel source. RDF can assist in the incineration of sewage sludge in the middle combustion stage of multiple hearth incinerators; co-pyrolysis has also been investigated. Small modifications to the fluidized bed may be made to the allow the use of fossil fuels instead of RDF for combustion of wet sludges. Refuse incinerators may provide hot air for flash-drying sludge at 1,300 F to a moisture content of 10-15%. Steam for multiple-effect sludge moisture evaporation in the Carver-Greenfield process may be generated by RDF. Sewage sludge composting with wood chips and suction aeration has been tested at the USDA Agricultural Experimental Station in Beltsville, Maryland; the use of RDF rather than wood chips or other bulking materials would eliminate the final compost-wood chip separation stage because of RDF's biodegradability.

D461

LIME/SODIUM BICARBONATE TREATMENT INCREASES SLUDGE DIGESTER EFFICIENCY,

Barber, N. R.

Church and Dwight Company, Incorporated,
Piscataway, New Jersey.

Journal of Environmental Sciences, Vol. 21, No. 2, p 28-30, 1978. 2 fig, 1 tab, 4 ref.

Combined lime and sodium bicarbonate treatment of sewage sludge during anaerobic digestion is evaluated. Methane-forming bacteria require a pH of 6.8-7.2 for optimum methane generation; neutrality is maintained by chemical treatment of the sludge to counteract the effect of acid-forming bacteria. When added to the digester to raise the pH, lime reacts with CO2 and can cause a vacuum to form at different CO2 partial pressures. In imbalanced digesters, the vacuum potential increases and air may flow into the digester with toxic effects on the methane-forming bacteria. Excess lime addition in the presence of CO2 can form insoluble calcium carbonate which will not increase alkalinity. The use of lime and sodium carbonate in anaerobic digestion reduces the toxicity of divalent cations. The combined treatment also reduces the presence of high pH patches in the sludge liquor. It is recommended that lime be added initially to increase the pH to 6.3-6.5, followed by sodium bicarbonate to increase pH to the optimum 6.5-7.2. The chemicals are added to maintain a digester alkalinity of 2,500-5,000 mg/liter as CaCO3 and a volatile acid concentration of 300-500 mg/liter as acetic acid. Sodium bicarbonate additions of 500 mg/liter/day will maintain a sodium concentration of 137 mg/liter; additions of 1,500 lb sodium bicarbonate/1 million gal influent sludge will increase bicarbonate alkalinity by 180 mg/liter when digester alkalinity falls below 2,500 mg/liter.

D462

THE COMPARISON OF ACTIVATED AND DIGESTED SLUDGE APPLIED TO FLOWERING CHINESE CABBAGE, BRASSICA PARACHINESIS BAILEY,

Wong, M-H., and Yip, S-W.

The Chinese University of Hong Kong,
Shatin,
Department of Biology.

Journal of Environmental Sciences and Health, Vol. A13, No. 3, p 241-251, 1978. 1 fig, 3 tab, 22 ref.

Flowering white Chinese cabbage (Brassica parachinensis) was cultivated in activated sludge and digested sludge mixed with garden soil and in garden soil alone. The cabbage seedlings, averaging 2 cm in height, were grown under sludge-to-sandy clay loam ratios of 1:500 and 2:500 dry weight; pH was maintained at 7 by liming. Heavy metal contents in the garden soil and amended soils were measured with atomic absorption spectrophotometry after one week; heavy metal uptake by plant tissues was measured at the end of the growing period. The flowering cabbage exhibited the highest growth rate in the 1:500 activated sludge-soil mixture, reaching a total dry weight after harvesting of 50 g. Plants grown in soil amended with digested sludge achieved a total dry weight growth of 40 g. Higher additions of digested and activated sludge did not enhance cabbage growth. At the 1:500 sludge-soil ratio, the edible portion of the plant tissues contained significant levels of Cd and Mg when cultivated with activated sludge and high levels of Cd, Mn, and Mg when grown with digested sludge. Plants grown at the 2:500 sludge-to-soil ratio had significant levels of Cd, Cr, Cu, Pb, Mn, and Mg after activated sludge amendments, and significant concentrations of Cd, Pb, Mn, and Mg with digested sludge addition. Although the plants did not exhibit symptoms of heavy metal toxicity, the significant heavy metal uptake by the plants grown with higher ratios of sludge was considered the reason for lower growth.

D463

RECLAIMED SEWAGE WATER: A HYDROPONIC GROWTH MEDIUM FOR PLANTS,

Wallace, A., Patel, P. M., Berry, W. L., and Lunt, O. R.

Resource Recovery and Conservation, Vol. 3, No. 2, p 191-199, May, 1978. 1 fig, 6 tab, 7 ref.

Greenhouse crops of chrysanthemum, tomato, egg plant, bell pepper, and lettuce plants were sustained by a hydroponic growth medium of secondary effluent waste water when insoluble iron oxide was applied to the plant roots during transplanting. The test plants were grown hydroponically for 7 weeks in processed and chlorinated-dechlorinated municipal waste water. Plants grown only in the sewage water were iron deficient; tests groups received foliar applications of 4 g/liter iron sulfate or direct root addition of 2-4 g/plant of insoluble iron oxide. The latter treatment produced growth equivalent to plants grown in complete nutrient solutions. An adequate supply of the major nutrients was available to the plants in the waste water; manganese was near the deficiency level in some test plants. Root retention of heavy metals did not cause toxicity to the plant or present a consumer health hazard potential. Acidification of the hydroponic media to pH 7.8, 6.5, 6.0, and 5.0 with sulfuric acid demonstrated that chrysanthemums and tomatoes overcame the iron deficiency problem at pH 5-6; lettuce growth was reduced at pH 5. Acidification increased the trace metal contents in the plants. Results of tests on mature crop response to waste water were comparable to those of greenhouse tests. Flow-through water from the mature crops was used to grow a cucumber crop in the greenhouse study. A two- to six-fold reduction in waste water trace metal concentrations by the mature plants was apparent; it was suggested that this higher quality water could be used for crop irrigation or algae production for cattle feed.

D464
LAND TREATMENT: PRESENT STATUS, FUTURE PROSPECTS,

Pound, C. E., Crites, R. W., and Reed, S. C.

Metcalf and Eddy, Incorporated,
Palo Alto, California.

Civil Engineering-ASCE, Vol. 48, No. 6, p 98-102, June, 1978. 2 tab.

Land treatment of municipal waste water is recommended as a cost-effective method of fulfilling the pollution abatement and grant guidelines established by the 1977 Clean Water Act. The Act increased the construction grants to 85% for innovative forms of waste water treatment; an additional 15% of life-cycle costs for these treatment methods is considered competitive with alternative conventional processes. The Clean Water Act encourages energy saving processes; land application conserves about 38,000 kilowatt hrs more annually than an advanced waste water treatment plant. It also supplies nutrients and water to soils and crops. Although capital costs, which are partially funded by the Act, are similar for a 25 mgd advanced treatment plant and a comparable land treatment system, non-fundable operation and maintenance costs are about $2 million/yr more for advanced treatment than land applications. Operation and maintenance costs of land treatment have been offset by 8-128% in established systems where crops are grown with the waste water applications. Land treatment, such as slow rate irrigation, rapid infiltration, and overland flow, does not produce sludge which requires further treatment.

D465
EXPERIENCES IN OPERATING SMALL PACKAGE-TYPE SEWAGE-TREATMENT UNITS,

Nicolle, N. P.

Water Pollution Control, Vol. 77, No. 1, p 112-115, 1978.

Problems associated with the operation and maintenance of small package sewage treatment plants are reviewed. Hand-raked screens can clog if they are not cleaned often enough, resulting in sewage overflows to the receiving water body. Covered stainless steel screenings containers with drainage holes should be emptied daily at a disposal site. Stone traps, which can be stirred to remove organic accumulations and sand, are recommended over detritus channels at the inlet to the sewage treatment plant. V-notched overflow weirs on the sedimentation tanks should be cleaned frequently to prevent high overflow rates. Biological filters are preferred for treatment; replacement of distributor arm parts may require professional engineers. Operation of vertical disc and surface aerators at maximum speeds can cause excessive oxygen concentrations; dissolved oxygen concentration tests should be performed regularly, as well as mixed liquor suspended solids content, oxygen absorption, COD, suspended solids, ammonia, and bacteriological tests. Final sedimentation tanks should be cleaned daily to prevent algae accumulations which can contribute to increased humus or activated sludge. Regular maintenance of sand filters is recommended for operation efficiency. Corrosion of chlorination equipment has often occurred due to chlorine leaks and improper handling of the equipment.

D466
DIFFUSED AIR SUPERSEDES MECHANICAL SURFACE AERATION AT OXFORD,

Lewin, V. H., and Henley, J. R.

Thames Water Authority, Vales Division,
London, England.

Effluent and Water Treatment Journal, Vol. 18, No. 4, p 163-165, 167, 169, April, 1978. 5 tab, 12 ref.

A diffused air aeration system and a Vitox liquid oxygen augmentation system were installed to supplement the mechanical surface aeration-activated sludge system in the sewage treatment works at Oxford, Sanford on Thames, England. Increased flows to the treatment plant necessitated nearly continual use of the 3.3 mgd diffused air system after installation to maintain effluent quality. The efficiency of the plant was improved when the aeration tanks were deepened from 2.44 to 5.0 m and the 40 aeration units were converted to accommodate the extra depth. Two Vitox pumps, supplying 0.5 tons 02/day, were later installed to provide supplementary oxygen during breakdowns and upgrading of the plant operation. This system was unable to improve effluent quality and could not provide adequate treatment in the event of a cone breakdown. Plastic concrete-weighted Venturators and an air compressor were purchased as an auxillary unit. An analysis of protozoa and rotifera in the surface aeration and diffused air systems indicated that Pertrichia, Rotifera Lecane, and Philodina were most abundant. Further upgrading and replacement of the surface aeration system, as well as advanced monitoring systems, tank drainage systems, mixed liquor ditribution chambers, and final clarifiers, are planned.

D467
WASTEWATER CHLORINATION BY JET DIFFUSION,

Lagrosa, J. J., Mandt, M. G., and Burde, G. F.

Water Pollution Control,
Ridgewood, New Jersey.

Public Works, Vol. 109, No. 4, p 71-73, April, 1978. 2 tab.

Waste water chlorination by water jet diffusion was incorporated into the 5 mgd contact stabilization-activated sludge treatment facility in Ridgewood, New Jersey, to reduce effluent fecal coliform counts. The jet disinfection unit, developed by the Pentech Division of Houdaille Industries, employs a Venturi reactor tube equipped with a jet plume. Waste water is pumped through the jet into the assembly, forming a vacuum which draws chlorine into the stream; the hydrolyzed hypochlorous acid formed is immediately lethal to the microorganisms at the proper pH. Effluent fecal coliform counts have ranged over 21-70/100 ml since the jet diffusion chlorination system was installed. The chlorine dosage has been reduced to about 18 lbs/million gal to maintain a chlorine residual of 1.0 mg/liter; BOD concentrations have been reduced by 90-94%.

D468
CHEMICAL CONDITIONING OF SLUDGE,

Macaulay, R. A.

Water Pollution Control, Vol. 77, No. 1, p 69-71, 1978. 3 fig, 1 tab, 3 ref.

Polyelectrolyte conditioning of sewage sludge prior to dewatering by centrifugation or vacuum filtration was investigated in tests at 25 South African waste water treatment plants. Organic primary, secondary, digested, and activated sludges were conditioned with Zetag 92 cationic polyelectrolyte. Chemical sludges were flocculated with Magnafloc 155 anionic polyelectrolyte. Solids contents were increased to 22.3-25.3% for primary sludges, 13.8-29.0% for digested sludges, and 8.8-17.3% for waste activated sludges. The anionic polymer increased solids contents in chemical sludges to 15.0-26.0%. A nonlinear relationship was established between the polymer dosage and the recovery percentage. Activated sludge required a significantly higher polymer dosage than digested sludge.

D469
BELT FILTER PRESSES: A NEW SOLUTION TO DEWATERING?,

Dembitz, A. E.

Water and Wastes Engineering, Vol. 15, No. 2, p 36, 38, 40, 41, 70, February, 1978.

Belt filter press and recessed plate press designs and manufacturers are discussed as alternatives to vacuum filters, centrifuges, gravity sludge dewaterers, and incinerators for municipal, activated, and industrial sludges. Belt filter presses usually incorporate an initial gravity drainage stage, followed by dewatering of sludge between a perforated and a solid continuous belt; 0.25-2.0 inches thick cakes can be obtained. Sludge conditioning with organic polymers has increased the potential dewatering capabilities of filter presses. Two-stage gravity dewatering belt presses, manufactured by Ecodyne and Permutit Cos., dewater 1-2% solids sludges to 14-16% solids content; units with widths of 3-6 ft cost about $50,000-70,000. A completely equipped system with 8-10 ft wide belts costs approximately $80,000-120,000. Three-stage belt filter presses are often required to produce an autogenously combustible sludge with a solids content of 25%. Recessed plate presses, operating at pressures of about 125 psi or more, have low power requirements and are capable of handling difficult industrial sludges; the numerous small precision parts of the units may make recessed filter plates more expensive.

D470
REST-AREA WASTEWATER TREATMENT,

Hughes, G. W., Averett, D. E., and Francingues, N. R.

Environmental Effects Laboratory,
United States Army Engineer Waterways Experiment Station,
Vicksburg, Mississippi.

Transportation Research Record, Vol. 631, p 30-36, 1977. 5 fig, 1 tab, 5 ref.

Various rest-area waste water treatment processes and problems associated with these in several states were reviewed as a preliminary step to developing design parameters for rest-area facilities that comply with P. L. 92-500. The principal methods of treatment encountered were: septic tanks with leach fields; facultative, aerobic, or totally evaporative lagoons; land application; and package extended aeration, activated sludge plants. Problems associated with the rest-area treatment processes were inadequate information on waste characteristics and incorrect calculation of flow fluctuations. Data on effluent characteristics, previously assumed to be similar to domestic wastes, demonstrated lower concentrations of BOD and suspended solids but higher ammonia levels and COD:BOD ratios. Miscalculations of rest-area usage originated in the practice of averaging percentages of daily traffic; a more accurate method for determining waste water flows utilized monthly traffic summaries and incorporated three peak-month averages. An extended aeration-activated sludge plant at a Mississippi rest-area was cited as producing an effluent in compliance with P. L. 92-500 standards.

D471

AN ION-EXCHANGE PROCESS WITH THERMAL REGENERATION - XXI. DESALTING OF SEWAGE EFFLUENTS,

Bolto, B. A., Eppinger, K. H., Ho, P. S. K., Jackson, M. B., and Pilkington, N. H.

CSIRO,
Division of Chemical Technology,
South Melbourne, Australia.

Desalination, Vol. 25, No. 1, p 45-59, March, 1978. 5 fig, 7 tab, 11 ref.

Thermally-regenerable ion exchange resins (Sirotherm), containing active microion exchange particles within a salt and water penetrable matrix, were evaluated for desalting of physio-chemically treated effluent, permeability of the matrix to organic wastes, and matrix structure modification to anion permeation. Treated effluent was passed through a column packed with 226 g of dry weight of resin, operated at an adsorption cycle of 50.5 min at 10-20 C and a regeneration cycle of 15.5 min at 80-90 C. Unprotected ion exchange resin performance dropped about 20% after 100 cycles and stabilized at 45% after 600 cycles. Two fouling stages of the resin were identified, the second occurring between 991-1300 cycles. Resin foulants comprised polymeric carboxylic acids; they were removed by trap resin Amberlite IRA 401S, which stripped more organics from the resin then others tested. When tertiary effluent from an activated sludge process was desalted, the resin was economically competitive with conventional ion exchange, but cost 60-85% of the operating costs for reverse osmosis and 60-120% of conventional chemically-regenerated ion exchange processes. Accidental fouling of the resin was eliminated with caustic brine treatment at 45 C, which also reduced anion diffusion through the matrix in some cases. An advantage associated with Sirotherm was the recovery of waste heat.

D472

FORMULATING PUBLIC POLICY ON LAND APPLICATION OF WASTEWATER AND RESIDUALS,

Emrich, G. H.

Water and Sewage Works, Vol. 125, No. 3, p 78-81, March, 1978. 7 fig, 4 tab, 12 ref.

Land application processes in operation for disposal of waste water and sludge were reviewed as guides for formulating public policy on land disposal. Overland flow as practiced in the marsh-pond system at Brookhaven, New York, removes a large quantity of the nutrients in waste water with minimal percolation of pollutants into the soil; groundwater and subsurface monitoring is recommended for overland flow sites. The Flushing Meadows rapid infiltration project in Phoenix, Arizona, releases about 80 mgd of activated sludge effluent to infiltration-percolation basins underlined with sand and gravel. Depending upon weather conditions, nitrogen removal varies from 30-90% at a distance 20 ft into the groundwater below the basins; phosphorus is reduced by 90% at a distance 100 ft from the basin. The suitability of spray irrigation is dependent upon soil, geologic, and groundwater conditions at the site; advantages of spray irrigation include economic nutrient supplements to crops and groundwater recharge. Spray irrigation of waste water has been successfully practiced at: Pennsylvania State University, University Park; Muskegon, Michigan; and Longwood, Pennsylvania. Land disposal of sludges in metropolitan areas is often unsuitable because of the heavy metal content originating from industrial wastes.

D473

CARBON REGENERATION FURNACE FOR COLESHILL,

Water Services, Vol. 82, No. 987, p 303, May, 1978.

An activated carbon regeneration furnace, manufactured by Sutcliffe Speakman and Co. Ltd. of Leigh, Lancashire, England, has been incorporated into the Coleshill advanced waste water treatment plant. Carbon slurry from the activated carbon plant is collected in a steel tank, dewatered, and passed by screw conveyors to the top of the regeneration furnace. The furnace is a 5 m high mild steel cylinder lined with refractory blocks and equipped with 7 manholed hearths with internal diameters of 1.5 m. A rotating central shaft, driven by a variable speed, nickel-chrome rabble arm, agitates the carbon in the 7 hearths as it falls through grates between the hearths during the drying process. The propane-fueled regeneration furnace also contains an air fan which generates combustion air at a rate of 5.6 cu m/min and burners which supply 200,000 Btu's/hr. The system has sequential starters for the conveyor and furnace drive motors; burners are individually controlled and monitored by an ultra-violet detection system. Waste furnace gases are saturated with water before they are scrubbed and emitted through the stack.

D474
FIXED-GROWTH NITRIFICATION OF SECONDARY EFFLUENT,

Gasser, J. A., Chen, C-L., and Miele, R. P.

Sanitation Districts of Los Angeles County,
Whittier, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE1, p 77-92, February, 1978. 7 fig, 6 tab, 3 ref.

Fixed growth nitrification of activated sludge liquor and alum-clarified raw and carbon-filtered raw sewage was investigated in two 1.73 m high columns. The columns were packed with gravel, silica sand, river-washed stone, or granulated activated carbon and operated at varying empty-bed detention times and temperatures to obtain effluent ammonia-N concentrations of less than 2 mg/liter. Backwashing was required to prevent solids accumulations. Secondary effluent was supplied to the columns at a rate of 0.29 gal/min/sq ft; air or pure oxygen was injected into one column. Successful nitrification of the activated sludge liquor was accomplished with the gravel filter medium. The sand medium was limited by solids accumulation; the alum-clarified and alum-carbon treated effluent was adequately nitrified in the fixed growth process. The correlation between temperature and empty-bed detention time influenced nitrification; 2 hrs detention time required 20 C, while 80 min detention required 25 C to reduce effluent ammonia-N to 2 mg/liter. No significant differences in nitrification were observed between air and oxygen aeration; pH adjustments were not required for activated sludge effluent. Influent COD concentrations above 90 mg/liter adversely affected nitrification and increased detention time requirements.

D475
CANADIAN-MADE BEARINGS PROLONG LIFESPAN OF PASVEER SEWAGE TREATMENT SYSTEM,

Water and Pollution Control, Vol. 116, No. 4, p 50, April, 1978.

Modifications to the aeration unit of the Pasveer sewage treatment system have increased the projected lifespan of the treatment facility in New South Wales, Australia. The Pasveer extended aeration system utilized a Mark I floating aeration unit containing two 6-ft rotors, supported by segmental bearings and driven at 75 rpm. Corrosive and abrasive material caused excessive wear on labrinth seals; materials invaded bearing casings. Case-hardened shaft sleeves reduced some of the wear. The Mark II unit incorporated 9-ft rotors supported by bearings, designed by Thomas-Gordon Ltd. of Hamilton, Ontario, Canada, consisting of a cast pillow block with a central thrust ring and two flanged, 270 degree segmented inserts. Oil is circulated through the bearings; the rubber thrust ring is covered with felt to prevent infiltration of abrasive material. The modular Pasveer unit also utilizes a gravity decanting system with a bellmouth.

D476
LAND TREATMENT OF WASTEWATER MAY BE KEY TO POLLUTION CONTROL,

Hartman, W. J., Jr.

Water and Sewage Works, Vol. 125, No. 5, p 82-83, May, 1978.

Instigation of land application as an alternative waste treatment program which produces no residual solids is dependent upon the coordination of the public, regulating institutions, and technical groups. Land treatment is applicable to communities limited to 1 million where suitable land is available. Restraining parameters, governed by the public, require consideration in the selection of land treatment sites. Out-right purchase of farmland for waste application is not recommended because of existing constraints placed upon the agricultural industry. Farm-city coordination is suggested, as well as localized land treatment sites rather than regionalized treatment. Sewage effluent regulations can be simplified and made consistent; technical plans and design parameters should be comprehensible to user groups. Land treatment techniques and regulations can be reduced by the institutional and technical groups to a form understandable by the general public. Groundwater, stream flow, and surface water supplies should be considered in the formulation of land treatment policies.

D477
MAKE SEWAGE WORKS WORK,

Malone, C. D., and Swann, P.

Associated Water and Air Resources,
Nashville, Tennessee.

American City and County, Vol. 93, No. 6, p 79-81, June, 1978. 2 fig.

Improvements in operation, maintenance, and performance of the expanded Archie Elledge Waste Treatment Plant in Winston Salem, North Carolina, included personnel training and reorganization and process modifications. The 36 mgd activated sludge plant, with a peak capacity of 54 mgd, was unable to maintain design effluent parameters soon after start-up. A consulting engineering firm was retained to perform plant reorganizations and evaluations. Operating personnel underwent a 20-hr on-the-job training program; operation and maintenance responsibilities were reorganized. High organic concentrations from one influent source were reduced by adding pretreatment with a second aerated lagoon with a 2 mgd capacity to operate in parallel with the existing 1.33 mgd aerated lagoon. Surge control was provided by varying the waste water depths in the lagoons. Anaerobic digester supernatant was returned to the pretreatment lagoons as a source of nitrogen rather than to the primary clarifiers. About 4,000 ft of polyvinyl chloride pipe was installed to divert the digester supernatant to the lagoons. Three additional aerators were installed in the activated sludge basins to increase dissolved oxygen concentrations. Effluent flows from the centerwells of the final clarifiers were reduced somewhat by increasing the diameter of one of the clarifier centerwells. Sampling procedures were automated; other process modifications are under consideration.

D478

WASTEWATER DISINFECTANTS: MANY CALLED - FEW CHOSEN,

Smith, J. W.

CH2M Hill, Incorporated,
Corvallis, Oregon.

Water and Wastes Engineering, Vol. 15, No. 6, p 18-25, June, 1978. 1 fig, 1 tab, 40 ref

Enteric virus survival rates in domestic sewage treatment and the formation of toxic compounds during waste water chlorination have led to questioning of the reliability of the coliform test as a means of assessing disinfectant performance, as well as a search for alternatives to chlorination. Numerous investigations have been directed toward characterizing chlorination byproducts and their associated toxicities, as well as evaluating methods for reducing residual chlorine concentrations in potable and waste waters. A variety of disinfectants are discussed with respect to current technology level, efficiency, energy consumption, toxic effects, and costs. Of the disinfectants currently being considered, ozone is cited as the most promising alternative to chlorine. Advantages of ozone include its powerful oxidizing nature, byproduct oxygen generation, and viricidal properties. Recent studies on ozone disinfection efficiency and the possible toxicity of ozonation intermediates are reviewed. Additional pilot studies on the use of bromine chloride, chlorine dioxide, and ultraviolet irradiation are described.

D479

OXYGEN-ACTIVATED SLUDGE PLANT COMPLETES TWO YEARS OF SUCCESSFUL OPERATION,

McDowell, C. S., and Gianelli, J.

Air Products and Chemicals, Incorporated,
Allentown, Pennsylvania.

1977. 195 p, 75 fig, 12 tab, 9 ref, 2 append. Technical Report EPA-600/2-77-040.

The conversion to and performance of an oxygen-activated sludge system installed in the Westgate municipal sewage treatment plant, serving Fairfax County, Virginia, is described. The report encompasses the first two years of operation of the $1.7 million oxygen-activated sludge plant, including start-up, optimization, operation, and problems. The treatment facility was upgraded from an 8 mgd aeration-sedimentation operation without sludge return to a 14 mgd oxygen-activated sludge system. The new system reduces BOD by 92%;

the former process reduced BOD by only 50%. The effluent produced by the oxygen-activated sludge system has consistently contained 10-15 mg/liter total BOD, less than 5 mg/liter soluble BOD, and less than 20 mg/liter suspended solids. Weekly oxygen requirements have averaged 0.7-1.0 kg 02/kg BOD removed, less than originally anticipated. After the optimization program was completed, sludge production increased to 1.4 kg total suspended solids/kg BOD removed; the sludge volume index has ranged from 35-110 mg/g total suspended solids.

D480
SOME HOT NEWS ABOUT SLUDGE,

Brough, K.

Portland Water District,
Maine.

Water and Wastes Engineering, Vol. 14, No. 8, p 22-26, August, 1977. 2 fig, 6 tab, 4 ref.

Zimpro heat-treated sludge was stored in 3-4 ft piles and applied to two one-acre plots seeded with silage corn. The sludge was placed on plastic sheets to reduce seepage; a portion of one pile was covered and leachate samples from both piles were collected after several weeks of storage. Sludge was applied to portions of the corn plots as the sole amendment or in conjunction with manure and chemical fertilizers. The Zimpro sludge contained about 3% total nitrogen, 0.5% phosphorus, and 0.1% potassium; leachate samples from one pile after heavy rain contained about 280 mg/liter total Kjeldahl nitrogen and 120 mg/liter ammonia. Plant growth was not as extensive in one of the plots treated with sludge and manure than in plots that had also received chemical fertilizers; no significant growth differences were observed in the other plot treated under the same conditions. Analysis of the corn tissue and crop yield showed no significant differences between the bulk yield and the heavy metal uptake concentrations for the different soil amendments. Odor problems in the stored sludge indicated the need to maintain aerobic conditions in the piles through aeration or mechanical turning. The sludge could be applied with conventional manure spreaders. High coliform counts in the sludge were attributed to contamination by transport and spreading equipment; negligible coliforms were found in the sludge soon after Zimpro heat treatment.

D481
THERMALLY CONDITIONED SLUDGE HAS AGRICULTURAL USES,

Water and Sewage Works, Vol. 125, No. 5, p 73-75, May, 1978.

Several municipalities practicing land application of thermally conditioned sludge are identified. The Zimpro sludge conditioning process employs compressed air and heating to 350 F to destroy pathogens and dewater the sludge to 25-50% solids. Thermally conditioned sludge from Jeffersonville and Speedway in Indiana, is applied to lawns, gardens, and some pasture land. Sludge from Indio, California, is conditioned and vacuum filtered at a rate of 6.4 tons/day for use as a fertilizer base by a fertilizer manufacturer. Ten tons/day of North Olmstead, Ohio, waste activated and primary sludge is thermally conditioned and supplied to residents and farmers or used to fill in hollows around the treatment plant. About 25,000 gal/wk of thermally conditioned and thickened sludge is injected or spread on crop and pasture land in Bedford Heights, Ohio, by the Ny-Trex company. Thermally conditioned sludge in Lancaster, Pennsylvania, is applied to silage corn crops; sludge from a second thermal unit for the county of Lancaster conditions wheat and corn crop soils at one farm. Denton, Texas, sludge is applied to hayfields and pasture land; Troy, Ohio, applies its sludge to a 30-acre municipal cornfield. Silage corn was successfully grown in tests at Portland, Maine, with thermally-conditioned sludge. The University of Florida has grown crops of turf grass in a mixture of thermally conditioned sludge, wood chips, sugar refinery wastes, sandy muck, and water treatment sludge.

D482

PHYSICO-CHEMICAL TREATMENT OF MUNICIPAL WASTEWATER. COAGULATION-FLOCCULATION,

Leentvaar, J., Buning, W. G., and Koppers, H. M. M.

Agricultural University,
Wageningen, The Netherlands,
Department of Water Purification.

Water Research, Vol. 12, No. 1, p 35-40, 1978. 8 fig, 6 tab, 13 ref.

Coagulation-flocculation of wastes primarily domestic in origin was investigated in pilot studies using ferric chloride, hydrated lime, and alum with and without coagulation aids. Treatment efficiency was evaluated according to effluent concentrations of total organic carbon, BOD, COD, suspended solids, ammonia, phosphorus, proteins, and low organic acids. At pH 5.3, a ferric chloride dose of 61 mg/liter reduced suspended solids by 93%, soluble organic carbon by 27%, and total organic carbon by 54%. Alum, added as 47 mg Al/liter at pH 5.9, removed 94% of the suspended solids, 24% of the soluble carbon, and 58% of the total carbon. A 520 mg/liter dose of hydrated lime at pH 11.0 reduced suspended solids by 90%; when ferric chloride was added as a coagulation aid, the removal efficiency of soluble carbon was increased from 17% to 23% and total organic carbon reduction was improved from 44% to 56%. Alum flocculation removed a larger percentage of the anionic detergents in the waste water than the other two flocculants; all three agents removed 99% of the orthophosphate and 14-18% of the ammonia. Cost comparisons concluded that ferric chloride was the most economical flocculant of the three tested.

D483

TREATING SLUDGES,

Environmental Science and Technology, Vol. 12, No. 5, p 511-512, May, 1978.

Sewage sludge treatment and disposal were the major topics of a symposium conducted by the Division of Environmental Chemistry of the American Chemical Society in March, 1978. Co-pyrolysis of sewage sludge and refuse-derived fuel was described as an innovative and alternative process of heat recovery, eligible for an additional 10% funding under P. L. 95-217. A co-pyrolysis system installed in the 30 mgd Central Contra Costa, California Sanitation District treatment plant, may supply up to 90% of the power for operating the plant and recalcining lime used in treating waste water. Pyrolysis, maintaining temperatures up to 2,400 F, destroys most toxic materials and oxidizes most heavy metals; the ash produced by pyrolysis occupies about 3-10% of the original sludge volume and is suitable as a soil amendment when metal content is not important. Sludge incinerators can be retrofitted with heat recovery units. Treating sewage sludge with molten alkali, sulfate, or oxide salts in a kiln at 550 C was suggested as a source of heavy metal recovery and toxic organic compounds removal. Costs associated with molten salt treatment of sewage sludge were estimated at $30/ton.

D484

OXYGEN ACTIVATED SLUDGE TRIALS AT PERSLEY,

Fuggle, R. W., Charlton, R. A., and Hutton, J. L.

Effluent and Water Treatment Journal, Vol. 18, No. 5, p 225, 228, 230-232, May, 1978. 7 fig, 2 tab, 5 ref.

A Wimpey Unox oxygen activated sludge pilot plant was installed in the Persley, Scotland, sewage treatment plant in an attempt to reduce the growth of filamentous bacteria causing poor sludge settling characteristics. About 15% of the waste water flow to the plant originated from a chicken processing plant, a dyeing operation, a fish processing plant, an animal breeding laboratory, and a refuse dump. The Unox pilot plant was operated on three test modes: 26 days at 2-6 hrs retention; 29 days at 1-7 hrs; and 29 days at diurnal variations of 1.7-1.0 hrs. Various recycle and biological loadings were also examined. Effluent BOD and suspended solids concentrations were reduced to less than 20 mg/liter and 22 mg/liter, respectively, at a bioloical loading of 0.6-0.9 kg BOD/kg mixed liquor volatile suspended solids/day. Sludge settling characteristics improved when the pilot plant was operated on the third test mode. A photomicrographic comparison of effluent from the Unox pilot plant and the original activated sludge plant showed a significant reduction in filamentous bacteria in the Unox effluent. Higher dissolved oxygen concentrations, larger and more active microbial populations, or higher carbon dioxide concentrations in the liquor were cited as possible factors involved in reducing filamentous bacterial growth.

D485
AERATION EQUIPMENT COSTS REDUCED BY NEW SYSTEM,

Water and Sewage Works, Vol. 125, No. 5, p 81, May, 1978.

Envirex Inc. manufactured the fiberglass-reinforced plastic rotary lift aeration unit which was installed in the 3 mgd Marshall, Michigan, waste water treatment plant. Selection of the unit reduced installation costs by 20%. The light weight PFT rotary lifts, reportedly comparable to stainless steel in corrosion resistance, reduced head losses and power costs because of their larger internal diameters and lower surface resistance; the 4-inch header had about the same capacity as a 6-inch steel header. Fiberglass-reinforced plastic pipe, molded urethane-rubber tees, elbows, and flanges, and glass-wound vinyl-ester upper and lower headers were used when the eight rotary lift systems were installed. The header assembly accommodated Envirex snap-on diffusers, superfusers, and air-locked crowns and was designed for uniform air distribution to the diffusers. The Marshall plant also provided primary treatment, final settling, and chlorination.

D486
HOT SPRINGS GETS REGIONAL TERTIARY TREATMENT PLANT,

Water and Sewage Works, Vol. 125, No. 5, p 92, May, 1978.

Upgrading of the sewerage and trickling filter waste water treatment plant in Hot Springs, Arkansas, included the construction of a $14.7 million tertiary treatment plant, new interceptors and force mains costing a total of $3.8 million, and three pumping plants costing $1.6 million. An additional 15,000 acres will also be sewered. The modular 12 mgd tertiary treatment plant, with a peak capacity of 30 mgd, provides primary aeration and settling, as well as degritting, coarse bar screening, and automatic primary sludge removal. The activated sludge system is aerated with high purity oxygen and mixed with three mechanical mixers; detention time is 1.33 hrs with a recycle rate of 30%. Gravity thickened primary sludge is mixed with waste activated sludge which has been thickened with polymers in a dissolved air flotation tank. The mixed sludge is heated to 350 F in a wet air oxidation tank for 15 min at 500 psi; the sludge is stored and supernatant is decanted. Two coil filters dewater the sludge to a cake suitable as a soil amendment. The activated sludge liquor is treated with alum and polymer for phosphorus precipitation and filtered through a 49-inch mixed media filter, prior to chlorination and discharge. Filter backwash water, which is also used for chlorination, wash down, pump seal, and fire extinguishing, is passed to the clarifiers after use. Screening, degritting, primary sludge removal, phosphate precipitation, and filter backwashing are computer-controlled.

D487
MOTORISATION OF PENSTOCKS,

Water and Waste Treatment, Vol. 21, No. 4, p 43, April, 1978.

Manually operated penstocks controlling aeration basin influent in the North London Beckton Sewage Treatment Works were motorized by the Retrofit Division of Rotork Controls Ltd. of Bath, England. Opening and closing of the eight manual penstocks required 40 min to accomplish the 118 penstock turns required. Actuators were installed on each of the eight tank walls using a specially designed bracket that permitted remote operation to conform with safety procedures. Mounting of the actuators for motorizing the penstocks utilized the existing penstock stem and position indicator. The push-button controlled penstocks required 6 min to open or close; future plans include the installation of remote control devices to operate the penstocks. Flow balancing in the aerators, as well as cleaning and maintenance operations, have been facilitated by the motorization of the penstocks.

D488
SEWAGE TREATMENT FOR SMALL COMMUNITIES,

Water and Waste Treatment, Vol. 21, No. 4, p 24, April, 1978.

The Biospiral operates as a submerged disc biological unit to treat waste water loads from populations of 10-880. The Biospiral unit is constructed of prefabricated steel and contains a rotating biological filter disc in the form of an Archimedean screw. Following biological treatment, effluent passes to an automatic drum filter for suspended solids removal. The Biospiral consistently reduces waste water pollutants to a BOD/suspended solids ratio of 20/30, with low maintenance and operation requirements. Effluent passes through a patented tertiary filter before discharge; sludge and liquor are continuously recirculated. The biodisc filter cloth is automatically cleaned; residue is returned to the plant inlet or passes to the sludge storage tank. The Biospiral is supplied by G. F. Dickson Environmental Engineering Ltd., ready for process and power connections. Additional Biospiral units can be installed for larger populations.

D489
DISSOLVED AIR FLOTATION TACKLES SLUDGE THICKENING,

Komline, T. R.

Komline-Sanderson Engineering Corporation,
Peapack, New Jersey.

Water and Wastes Engineering, Vol. 15, No. 2, p 63-67, 69, February, 1978. 2 fig, 2 ref.

The performance and costs of dissolved air flotation in thickening waste activated sludge were evaluated in pilot plant studies conducted at 20 municipal treatment plants and industries using the Komline-Sanderson, Peapack, New Jersey, HR-400 flotation unit. The flotation unit can thicken sludge at a rate of 2.25 lbs dry solids/sq ft/hr with a 4% float concentration and a suspended solids removal rate of 95%. Units often operate at double the capacity when sludge is of normal quality; the overall design of the unit permits adequate thickening of difficult sludges. The flotation unit is designed to operate at a recycle rate of 2 gpm/sq ft, retention of tank pressure of 60-70 psi, pressure, 75-95% air saturation, and an air/solids ratio of 0.035. Solids contents of sludges conditioned with polymers are usually 1% higher than sludges treated without polymer flotation aids. In the flotation unit, influent and recycled sludges are mixed with an air/polymer mixture to form a surface sludge blanket 8-24 inches thick above the waste water surface. A skimmer unit equipped with fixed vertical blades moves the flotating sludge along the surface of the flotation tank; a bleaching plate horizontally mounted before an inclined ramp also moves the sludge. Effluent is reaerated with aeration eductors in a retention tank to increase the air/water surface interface. The high dissolved oxygen content of the sludge contributes to lowering BOD in the influent activated sludge. Float suspended solids concentrations have ranged over 2.5-12% in the pilot plants studied; costs associated with dissolved air flotation are reviewed.

D490
RUGGED SELF-PRIMING PUMPS,

Water Services, Vol. 82, No. 987, p 290, May, 1978.

Gorman-Rupp 'T' series self-priming pumps, supplied by Wade Engineering Ltd. of Brighton, England, can upgrade existing or outmoded sewage treatment plants. The pumps can provide recirculation, storm flow balancing, and sludge removal without excessive structural modifications to the plant. The Gorman-Rupp seal protects the pump; when weather proofing and anti-frost heating elements are incorporated into the pump's design, no housing is required. Complete pumping units with motor and bedplate or bareshaft units, attachable to an electric motor, are available in 75, 100, 150, 200, and 250 mm sizes. The T4 series can accommodate 75 mm solids, 33.5 m heads, a discharge of up to 530 gal/min, and connection to suction lifts up to 7.6 m.

D491
NEW JERSEY PLANT TO TURN SLUDGE INTO COMPOST,

Solid Wastes Management, Vol. 21, No. 5, p 12, May, 1978. 1 fig.

The $2.1 million sludge composting plant in Camden, New Jersey, will reduce sludge treatment costs to $35/dry ton from the $109/wet ton cost associated with ocean disposal. The pilot plant was constructed with a design developed by the United States Department of Agriculture's Beltsville, Maryland, research facility. The sludge is mixed with wood chips in a 1:2 ratio by volume and deposited on a compost pad. The compost pad is underlined with a piping system to draw air through the sludge. The sludge and wood chip pile is covered by a layer of recycled wood chips or composted sludge. After three days, the sludge reaches a temperature of 160-170 F. The compost pile is dismantled after 21 days and allowed to cure for an additional 30 days. The compost is then separated from the wood chips, which are reused. The high composting temperature kills pathogenic bacteria; the pilot plant has a 15 ton/day sludge capacity.

D492
NEW CONCEPT CLAIMED FOR SEWAGE AERATION,

Journal of the Institution of Engineers (Australia), Vol. 50, No. 7, p 56, April, 1978.

Pacific Pumps has begun distribution in Australia of submersible turbine aerators suitable for activated sludge, aerobic digestion, sludge oxidation lagoons, and flotation processes. The aerator turbine, with a Frogman submersible motor, does not rely on a fan or compressor. Waste water is drawn into the turbine through an intake at the base; the effluent is mixed with air drawn in through a tube. The high speed rotation of the turbine provides thorough mixing; air and waste water are discharged automatically. Units are manufactured with capacities ranging over 25 cu m/hr to 200 cu m/hr; motor sizes range over 1.5-11 kilowatts. Due to the high oxygen intake and absorption values achieved by the aerators, these units are reportedly suitable for high strength sewage and industrial wastes.

D493
SLUDGE HANDLING AND DISPOSAL PRACTICES AT SELECTED MUNICIPAL WASTEWATER TREATMENT PLANTS,

1977. 60 p, 12 fig, 8 tab, 2 append. Technical Report EPA-430/9-77-007.

Sludge treatment practices of 46 of the 54 members of the Association of Metropolitan Sewerage Agencies are described. Flow charts of plant processes, capacities, and sludge generation are detailed for the 98 plants studied; the majority of the plants reviewed are located in heavily populated urban areas. Processes for treatment of primary, secondary, and combined sludges are analyzed and associated costs are presented. The most frequently employed methods of sludge treatment, in descending order, are: anaerobic digestion, gravity thickening, and vacuum filtration; centrifugation and incineration are also reviewed. Current and future demonstration and research projects are discussed, as well as nontechnical data associated with sludge management.

D494

USE AND MISUSE OF CHLORINATION FOR THE PROTECTION OF PUBLIC WATER SUPPLIES AND THE TREATMENT OF WASTEWATER,

Dugan, P. R.

Ohio State University,
Columbus,
Department of Microbiology.

American Society for Microbiology News, Vol. 44, No. 3, p 97-102, 1978. 1 fig, 24 ref.

While chlorination of drinking water supplies is justified for removing coliforms, viruses, and other pathogens, chlorination of waste water is considered more hazardous than the pollutants the treatment seeks to reduce. The low BOD water that is disinfected with chlorine has fewer organics with which chlorine can react than raw waste water and sewage. Hypochlorous acid has been found to be an effective bactericide while the hypochlorite ion has potential viricidal properties. Chloramines, a combined chlorine residual formed by reaction with ammonia or other substances, have been found to cause methemoglobinemia in uremia patients, genetic mutations in Bacillus subtilis, and sterility in several species of marine invertebrates. Other compounds which may form chloramines are urea, amino acids, proteins, other amines, and whole cells. The chlorine demand of these compounds must be satisfied with break point chlorination before free residual hypochlorous acid or hypochlorite ion will predominate. Chlorination also produces toxic compounds that are often resistant to biological degradation. Polychlorinated phenols and cresols, chloranil, trichloroanaline, and non-aromatic oxidation products have been formed within 2 hrs of sodium hypochlorite contact with small concentrations of industrial waste products, such as phenol, meta-cresol, hydroquinone, analine, and dimethylamine. Ozonation and more efficient secondary and tertiary treatment of waste water are recommended as alternatives to chlorination.

D495

TEXAS UTILITY TAPS MUNICIPAL SEWAGE PLANT FOR DEPENDABLE COOLING WATER SUPPLY,

Combustion, Vol. 49, No. 11, p 31-32, May, 1978. 1 tab.

Tertiary treated municipal effluent from Amarillo and Lubbock, Texas, is used as cooling water in Southwestern Public Service Company's mechanical draft cooling towers for power generation. The tertiary treatment plant has a capacity of more than 18 mgd and will conserve a daily potable water supply for 75,000 people. Tertiary treatment consists of a high contact cold-lime reacting clarifier, designed by the Graver Division of Ecodyne Corp., in which chemical flocculants precipitate suspended solids in a flash mixing zone. PH is adjusted with alum and lime, as well as carbonates and carbon dioxide gas contained in well water; phosphates are reduced to less than 1.0 mg/liter. Reverse osmosis units further treat the tertiary effluent for use as boiler make-up water, reducing suspended solids, trace organics, and colloids by 85%. Cooling tower blowdown is used to irrigate agriculatural crops; sludge from tertiary treatment will supply the additive requirements of the stack scrubbers at one power plant to be completed.

D496
OXYGEN INJECTION SYSTEM,

Effluent and Water Treatment Journal, Vol. 18, No. 6, p 289, June, 1978. 1 fig.

BOC Vitox oxygen injection systems have been installed as an alternative to plant expansion in several English waste water treatment plants where aerators were overloaded. The Vitox system, supplied with liquid oxygen in vacuum insulated containers, injects oxygen into activated sludge tanks when dissolved oxygen levels fall below a preset level. Oxygen is mixed with process liquor, pressurized to 2-3 bars in a venturi-type blender; the mixture is pumped to the oxygen deficient area. The bubble-bearing liquid is discharged through a high velocity expansion nozzle which shatters the oxygen bubbles to a readily dissolvable size as they are released with the liquid. The Vitox system promotes rapid mixing and 95% oxygen dissolution. One kg of BOD is removed for each kg of oxygen; oxygen may also be generated on-site rather than supplied in contained liquid form. Several Vitox systems already in use augment aerators during diurnal or seasonal peaks, reduce odor problems at plant inlets, and reoxygenate contaminated rivers.

D497
THROUGH A GLASS DARKLY,

Effluent and Water Treatment Journal, Vol. 18, No. 6, p 295, June, 1978. 2 ref.

Fouling potentials and prevention methods are discussed for anion exchange resins. The presence of organics and a high organic-to-inorganic dissolved ion ratio in the influent can lead to fouling, breakthrough, high organic loading, and a high residual on the anion exchange resin. When waste water containing fulvic or humic acids with a high inorganic ion concentration is treated on a cation/anion exchange system, subsequent anion exchangers, especially in mixed beds, may be damaged. Anion exchangers with a high reversibility to organics and a large total available capacity will perform more efficiently and resist organic accumulations. Weak bases are preferred over strong bases for resistance to organics. Gels rather than macroreticular resins provide higher capacities. Mixed bed operations have shown the highest susceptibility to fouling by acid fixation of the organics. Matrix and macroporosity have improved weak and strong base resins; physical stability, bead integrity, bead shape, and hydraulic properties are considered the important parameters in macroporous resins. Backwash characteristics and organic reversibility by polymers are considered important features of anion exchange resins.

D498
LIME/NA2CO3 TREATMENT IMPROVES SLUDGE DIGESTION,

Jacobson, A. R.

Illinois State University,
Normal,
College of Applied Science and Technology.

Public Works, Vol. 109, No. 7, p 94, July, 1978.

Lime and sodium bicarbonate treatment of anaerobically digested sludge provides the optimum pH for methane-forming bacteria. A natural buffer system established by digesters is based on bicarbonate alkalinity from the reaction of ammonia and carbon dioxide to form ammonium bicarbonate. The optimum pH for growth of methane-producing bacteria is in the range of pH 7.0. Lime will adjust the pH of the digester to 6.3-6.5. Sodium bicarbonate further increases the pH to 7.0-7.4. When digester bicarbonate alkalinity falls below 2,500 mg/liter, a 1,500 lb/million gal sodium bicarbonate addition will increase the alkalinity by 180 mg/liter. Treatment with sodium bicarbonate in addition to lime prevents lime overdose or localized pH variations.

D499
SWISS TUNNEL CONFIRMS MINI'S URBAN ROLE,

Water Services, Vol. 82, No. 988, p 361-362, June, 1978.

Atlas Copco's Mini Fullfacer tunnel driving system was selected over conventional blasting, drilling, and boring techniques to construct a 250-m long sewage tunnel that ran under railroad tracks, a church, and several houses in Laufen, Switzerland. Rock cover below the railroad bed ranged from 1.5-2.0 m. The Fullfacer, equipped with a conveyor belt and 2.5 cu m diesel dumper for muck removal, power connections, ventilation system, and laser directional control, completed the tunnel within 1 mo. The unit undercut rock and broke the mass toward the free face, a process requiring less power than drilling or blasting. The Fullfacer unit initially cut a right hand curve with a radius of 80 m and proceeded to excavate at a rate of almost 15 m/day. The 1.5 m vault of the tunnel beneath the railroad bed did not require reinforcement because of the 1,000-1,300 bar compressive strength of the area's limestone.

D500
MOTORISED VALVE SYSTEM FOR SLUDGE VESSEL,

Pipes and Pipelines International, Vol. 23, No. 3, p 31, June, 1978.

Rotork Controls Ltd. of Bath, Avon, England, designed the centralized electric valve actuators installed on the sewage sludge disposal ship, MV Garroch Head. Four valve actuators were installed on the 254 mm butterfly valves which control the loading hoppers; 22 were connected to the 500 mm equalizing and discharge valves; and 8 were mounted on the 406 mm ballast flooding valves. The actuators provide centralized and individual push-button control of the sludge loading, discharging, and ballasting operations. The ship was capable of loading 3,400 tons of sludge in one hour and discharging the cargo in about 8 min with the Rotork valve actuators. The actuators on the ballast flooding valves allowed easy trim adjustment and tuning.

D501
HYDROGEN PEROXIDE ELIMINATES ODOR IN WASTEWATER TREATMENT PLANT,

Water and Sewage Works, Vol. 125, No. 7, p 27, July, 1978.

Hydrogen peroxide was injected into force mains, pumping stations, and wet wells to reduce sulfide odors and corrosion problems at the Manatee County, Florida, waste water treatment plant. Odors, especially prevalent during the summer months, were attributed to water temperatures up to 85 C, a relatively flat sewer system layout, and low flow in sewers in certain areas. Paint on some houses near the plant was actually discolored by the hydrogen sulfide gas. Du Pont's Tysul WW hydrogen peroxide was injected by metering pumps into 12 sites located along the sewer system. The hydrogen peroxide was stored at the sites in 500 gal tanks. Chlorine injections of 100-200 ppm into lift station lines provided only temporary relief; permanganate and chemical injections were also ineffective. Hydrogen peroxide injection also eliminated corrosion problems; the cost of the deodorization system was an estimated $5/yr/residence.

D502
DUAL PURPOSE VEHICLE,

Water and Waste Treatment, Vol. 21, No. 6, p 25, June, 1978.

R. Bradley Municipal Vehicles Ltd. of Clay Cross, Derbyshire, England, has begun production of a modified BMV 5000 vehicle to collect both sewage and solid refuse. Designed especially for sewage and refuse collections in rural areas, the BMV dual purpose vehicle is a modified BMV 5000 refuse collection truck equipped with two 200 gal tanks constructed of alloy welded plates. The sewage tanks, bolted beneath the truck's body, have 18 inch diameter screw-sealed filler caps; the tanks are drained by gravity through 6 inch diameter convoluted hose. The standard BMV refuse collection vehicle consists of a Dodge G11 chassis with a 10-ft wheelbase containing 13.5 cu yds body space with a 1 cu yd hopper. The hopper has a rammer blade and ripper teeth for refuse collection. The BMV dual purpose vehicle will eliminate the need for two separate weekly trips to rural areas for sewage and refuse collections.

D503
FILTER BED FLOOR TILES,

Water and Waste Treatment, Vol. 21, No. 6, p 31, June, 1978.

E. C. C. Quarries Ltd. of Croft, England, has begun production of completely concrete filter bed floor tiles for waste water treatment plants. The precast filter tiles are constructed of sulfate-resistant cement concrete in an average scale of 2.5 tiles/sq m and up to 700 mm square. The tiles have a crushing strength above 50.0 Newton/sq mm at 28 days and are supplied with layout designs which include ducts up to 300 mm wide for solid bed floors. It is reportedly possible for two employees to install a floor 22 m in diameter within 8 hrs; lifting cradles for direct installation of the bed by a crane are provided. The floor tiles supply full coverage of the filter bed, maximum drainage, and basal aeration.

D504
DRAINAGE AND SEWAGE PUMPS,

Water and Waste Treatment, Vol. 21, No. 6, p 41, June, 1978.

Sweden's Pumpex A. B. drainage and sewage pumps will be distributed in England by Sykes Pumps Ltd. Pumpex manufactures six drainage pumps with output capacities of 70-840 gpm. Two models are equipped with torque flow impellers for solids handling and are available with rubber liners for abrasive solids loads or without liners for pumping sludges and non-abrasive slurries. Voltage ratings range over 240 or 110 volts for single phase to 415 or 550 volts for three phase. The drainage pumps with diameters down to 285 mm are suitable for narrow trenches and other restricted areas; all the drainage pumps can operate in series or in parallel configurations. Submersible sewage pumps are available as mobile units or stationary units attached to a wet sump or submerged in a wet pit. The modular pumps may be supplied with single channels or with torque flow impellers with solids capacities up to 125 mm. The 56 torque flow impeller equipped models have capacities up to 1,210 gpm; single channel pumps are available in 40 models with capacities up to 2,100 gpm. The wet pit submerged pump units may be raised for maintenance by disconnecting the volute positioned at the bottom of the sump. Sewage pumps have voltage ratings of either 415 volts in three phase or 240 volts single phase.

D505

WASTEWATER TREATMENT PROBLEMS AT NORTH KANSAS CITY, MISSOURI,

Schmidt, P. J.

Black and Veatch, Consulting Engineers,
Kansas City, Missouri.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 635-644, April, 1978. 5 fig, 3 tab.

On-site data collections, bench scale studies, and an activated sludge pilot plant evaluated treatment inefficiencies and corrosion problems at the 7 mgd North Kansas City primary waste water treatment plant in Missouri. About 90% of the BOD in the influent stream originated from food processing plants, paint factories, soft drink bottling, paper processing, and grain storage and milling operations. The influent had temperatures ranging over 29-41 C and a low pH. BOD was reduced by 1-17% and suspended solids by about 90%; hydrogen sulfide concentrations ranged over 0.3-5.0 mg/liter. Besides primary settling, the plant also provides vacuum sludge filtration. Sludge septicity in the primary tanks was caused by sludge blankets up to 1 m deep in the center of the tank; a picket fence unit installed in one tank reduced the sludge blanket to less than 130 mm and improved BOD removal. Bench scale tests demonstrated that further BOD removal could be achieved with 25-50 mg/liter additions of ferric chloride as a flocculating agent. The activated sludge pilot plant study concluded that BOD could be reduced by 89-99% to an average of 53 mg/liter and suspended solids could be reduced by 78-95% to 20 mg/liter average with aeration for 20 hrs.

D506

CONTACT STABILIZATION TREATMENT OF A COLLOIDAL ORGANIC WASTEWATER,

Kharajian, H. A., and Sherrard, J. H.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 645-652, April, 1978. 6 fig, 1 tab, 22 ref.

Parameters influencing the biodegradation of a colloidal organic waste water during contact stabilization treatment were studied in a continuous flow bench-scale activated sludge unit containing a contact tank, a sedimentation basin, and a stabilization tank with regulated sludge wastage and recycle. Synthesized waste water containing diluted colloidal yogurt, beef extract, inorganic nutrient salts and a colloidal COD content comprising 45% of the total 420 mg COD/liter was used in the study. The contact tank had a hydraulic retention time of 2.2 hrs and was mechanically mixed and aerated. Sludge recycle from the sedimentation basin was maintained at about 15 ml/min; the stabilization tank had a hydraulic retention time of about 4.9 hrs. Mean cell residence time varied over 0.77-4.2 days in the contact tank and 3.2-22.1 days in the total system. High levels of COD removal at low mean cell residence times in the contact tank were observed and did not impair sludge settling properties.

High specific utilization rates were maintained in the contact tank because of the sludge settling properties and low hydraulic retention times. Factors causing the observed yield to decrease at lower cell retention times were not clear. About 82.2% of the microbial solids in the contact tank were transferred to the stabilization tank, compared to an average of 17.2% in the steady state systems.

D507

ANAEROBIC DIGESTION AND MEMBRANE SEPARATION OF DOMESTIC WASTEWATER,

Grethlein, H. E.

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Hanover, New Hampshire,
Thayer School of Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 754-763, April, 1978. 3 fig, 4 tab, 8 ref.

A domestic septic tank was converted to an anaerobic digester with a variable stroke piston pump and equipped with a flat sheet semipermeable membrane module and a Helicore reverse osmosis unit operated in cyclic and continuous flow patterns. Under an on-off cyclic operating time of 2 min, a steady flux of 490 liters/sq m/day was achieved with the flat sheet membrane at a bulk velocity of 22.9 cm/sec. The membrane did not foul during cyclic operation because of the backflow when the pump was turned off. Flux during cyclic operation was maintained in the flat semipermeable membrane for 1,500 hrs and in the reverse osmosis membrane for 8,500 hrs. A bulk fluid velocity of 15.2-122 cm/sec over the membrane surface was possible, depending upon the operating cycle. The anaerobic digestion rate within the septic tank more than tripled because of higher concentrations of microorganisms and substrate; BOD was reduced by 85-95%. The system completely removed turbidity and E. coli and reduced nitrate by about 75%. The process by which insoluble phosphate was removed could not be identified.

D508
ULTRAFILTRATION OF COMPLEX WASTEWATERS: RECYCLING FOR NONPOTABLE USE,

Bhattacharyya, D., Jumawan, A. B., Jr., Witherup, S. O., and Grieves, R. B.

Kentucky University,
Lexington,
Department of Chemical Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 846-861, May, 1978. 15 fig, 5 tab, 24 ref, 1 append.

Charged, non-cellulosic membrane ultrafiltration of laundry and shower waste water produced a reusable, non-potable water supply that was shown not to be an irritant or toxin to mice and rabbits in oral, ocular, and dermal application tests or to human skin. Synthetic laundry wastes containing a nonionic surfactant, polyphosphates, silicates, hypochlorites, clay, and oil, and synthetic shower wastes containing aliphatic acid soaps, toothpaste, hair oil, shampoo, insect repellent, sodium orthophenylphenolate, and soil, were filtered in an ultrafiltration module operated at a channel velocity of 500 cm/sec and a transmembrane pressure of 560 kiloPascals. A 90% water recovery was predicted by computer scale-up of the model data at a feed flow rate of 1,000 cu cm/day; 90% of the organic carbon and phosphate and 52% of the dissolved solids were removed from laundry wastes at this performance level. A 75% reduction in organic carbon and a 45% removal of dissolved solids were attained with 90% recovered shower wastes. Refiltration of ultrafiltered waste water mixed with 10% make-up water was evaluated with curves describing organic carbon and dissolved solids accumulations on the membrane and residuals in the water. Toxicity and irritation by the recycled water were negligible in tests with mice, rabbits, and humans.

D509
SHOCK LOAD ATTENUATION TRICKLING FILTER,

Cook, E. E., and Herning, L. P.

Southern Illinois University,
Carbondale,
Department of Thermal and Environmental Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE3, p 461-469, June, 1978. 6 fig, 8 ref.

The kinetics of shock load attenuation by trickling filters were examined in a laboratory-scale filter with interchangeable sections. An 8-ft column stacked with 8 plastic media-packed boxes, each providing 27 sq ft of media surface area, was fed at four organic loading rates: 200 mg/liter COD or 400 mg/liter COD at 200 gal/day/sq ft; 400 mg/liter COD or 800 mg/liter COD at 400 gal/day/sq ft. During each run, the bottom filter box was successively moved to the top of the stacked column and exposed to the four organic loadings. After eight runs, the trickling filter configuration had resumed the original arrangement. As the top box was moved down through the column, COD removal efficiency decreased; the COD reduction by the first box was relatively constant at the highest organic loading, independent of its position in the filter. Boxes from the middle and lower depths in the filter were capable of higher substrate removal when placed at or near the top of the filter; when in the higher positions, these boxes received higher organic loadings than in the steady-state position. The ability of the trickling filter to accommodate shock loads was attributed to a reserve capacity of starved bacteria in the lower parts of the trickling filter. Under shock loads, the upper strata of the filter, operating at maximum metabolic capacity, allowed organic wastes to trickle to the lower starved biota. The stabilization of COD removal efficiency implied the presence of a COD saturation point.

D510

ELECTRO-OXIDATION OF AMMONIA IN WASTE WATER,

Marincic, L., and Leitz, F. B.

Harvard Medical School,
Boston, Massachusetts,
E. P. Joslin Research Laboratory.

Journal of Applied Electrochemistry, Vol. 8, No. 4, p 333-345, 1978. 9 fig, 7 tab, 11 ref.

Electrocatalysts and optimum operating conditions were defined for the electrooxidation of ammonia at concentrations of 2-170 mg/liter in waste water. A three-electrode cell was employed to test the suitability of platinum, titanium, tantalum, Teflon-bonded platinum, and graphite-bearing platinum as electrocatalysts; platinum was the only material which sustained an adequate peak current density of 2.30 milliamperes/cm during oxidation of 100 mg/liter ammonia at pH 8. A continuous flow bench-scale electrolytic cell containing a platinized titanium anode and stainless steel cathode was operated at various ammonia concentrations, flow rates, current densities, electrode potentials, and spacer thicknesses. The optimum current density for ammonia oxidation was about 0.476 milliamperes/sq cm. Low current densities (0.158 milliamperes/sq cm) produced the highest current efficiency; current efficiency ranged over 13.5-40.2%. Ammonia conversion ranged over 25.3-56.9% under influent concentrations of 27-30 mg/liter. A commercial powder platinum catalyst with a platinum loading of 30 mg/sq cm achieved 23.7-40.8% ammonia reductions at a current efficiency of 25%. While the process was considered technically feasible, the high cost of platinum was considered to make the process economically unattractive.

D511

HEAT TREATMENT AND LOW PRESSURE OXIDATION OF AQUEOUS SEWAGE SLUDGE,

Ottengraf, S. P. P., and Lotens, J. P.

Eindhoven University of Technology,
The Netherlands,
Laboratory for Physical Technology.

Water Research, Vol. 12, No. 3, p 171-178, 1978. 15 fig, 6 tab, 12 ref.

The impact of wet-air oxidation and heat treatment on the specific filtration resistance, COD, nitrogen, and phosphorus of liquid sewage sludge was measured in laboratory and full-scale tests. The laboratory reactor was operated at 160, 180, and 200 C for 0.5, 1.0, and 2.0 hrs; pressure was maintained at 26 atm and gas flow at 3.6 liters/hr. Laboratory results indicated that filtrate COD increased with increasing residence time at the lowest temperature; the lowest specific resistance of 16,000,000 sq sec/g was achieved at 180 C and 0.5 hrs. Phosphorus was not readily dissolved and nitrogen in the dry solids decreased slowly. A full-scale Zimpro wet-air oxidation unit was operated at 165 and 185 C with a mean cell residence time of 48.5 min; the COD conversion rate in the reactor was calculated at 5.2%, although the observed COD reduction was 10-15%. Operation at 165 C required 45,000 kilocalories/hr more heat than at 185 C, representing a 20% increase in steam consumption. Sludge treated at 185 C had a mean filtration resistance of 80,000,000 sq sec/g, compared to 600,000,000 sq sec/g at 165 C; this increase was attributed to axial mixing of the liquid phase in the reactor. Heat treatment at 160, 180, 200, and 220 C with nitrogen pressurization demonstrated that filtration resistance decreased with increasing temperature and residence time up to a certain point. With a constant residence time, specific resistance decreased significantly in the range of 150-160 C; heat treatment did not increase sludge resistance over that of wet-air oxidation.

D512

SINGLE VESSEL ACTIVATED SLUDGE TREATMENT FOR SMALL SYSTEMS,

Goronszy, M. C.

Process Biochemistry, Vol. 13, No. 6, p 19-25, June, 1978. 6 fig, 3 tab.

Sequential operation of single vessel activated sludge treatment is suitable for small scale systems accommodating fluctuating hydraulic and organic loads. Single vessel systems operate at a food-to-microorganism ratio of 0.05 kg BOD applied/day/kg mixed liquor suspended solids, with extended aeration at a rate of 2.4 kg O2/kg BOD applied/day. A six-hour cyclic operation, with a 100 min storm cycle, provides up to 18 hrs aeration; nitrification or denitrification can be induced by adjusting the aeration time. When nitrification in a six-hour cycle is desired, the waste water is aerated for 4.5 hrs, following settling and decanting; denitrification requires 3 hrs aeration after 1.5 hrs of anoxic conditions and a 50% higher oxygen transfer rate. Because a larger settling area is provided, sludges with poor settling properties can be more readily accommodated in sequential than in continuous systems. Shallow vessels for populations of 500-2,000 have a maximum depth of 1.5 m, with an endless channel or racetrack configuration. Shallow vessels utilize a decant rate of 34 liters/sec for a 500 person unit; decantation is performed by a cast iron bellmouth which is steadily lowered over the 30 min decant period. Oxygen transfer, dependent upon the depth of aeration float immersion, varies over 4.2-5.2 kg 02/hr m. Rectangular vessels, with diffused or mechanical aeration, provide treatment for larger populations of up to 4,000.

D513

PURE OXYGEN ACTIVATED SLUDGE SYSTEM TRANSFERS OXYGEN RAPIDLY,

Huang, J. Y. C., and Mandt, M. G.

Environmental Systems Department,
Calspan Corporation,
Buffalo, New York.

Water and Sewage Works, Vol. 125, No. 6, p 98-100, 102-103, June, 1978. 7 fig, 2 tab, 16 ref.

Pure oxygen and air activated sludge systems were compared in terms of power requirements, solids separation characteristics, sludge yield, and substrate removal kinetics. Oxygen generators included cryogenic air-separation systems for large plants, requiring about 350 kilowatt hrs/ton 02, and pressure-swing adsorption systems for small operations, consuming 380 kilowatt hrs/ton 02. Oxygen dissolution and mixing equipment required 23.8 brake hp/hr to dissolve 83.3 lb 02/hr. Power requirements for oxygen aeration were shown to be economically competitive with air systems only at high mixed liquor dissolved oxygen concentrations. Sludge settling characteristics in oxygen systems were not significantly different from those of air systems operated at the same solid retention time, mixed liquor suspended solids concentration, and mixing intensity. Sludge solid contents of 2.0-3.0% have been achieved in both oxygen and air systems; a dissolved oxygen level of 1.0 mg/liter, which could be maintained by either system, contributed to sludge settleability and decreased sludge production. The reduced aeration tank size required for oxygen systems was offset by a larger clarifier size required at suspended solids levels in excess of 3,000-5,000 mg/liter. There were no significant differences in sludge yield or substrate removal kinetics between pure oxygen and air activated sludge systems.

D514

THE APPLICATION OF SURPLUS SLUDGES FROM HUMAN WASTE DISPOSAL PLANTS TO SANDY SOIL (2) - THE EFFECT OF MIXING SLUDGE ON THE PHYSICAL PROPERTIES OF THE SOIL (HAMAKAIDA SANDY LOAM) (Shinyo shorijo ni okeru yojo odei no shashitsu dojo en riyo (2) - dojo no butsuriteki seishitsu ni oyobosu odei kongo no eikyo),

Kataoka, I., and Kataoka, I.

Kochi University,
Japan,
Laboratory of Applied Analytical Chemistry,
Department of Agriculture.

Kochidaigaku Gakujutsu Kenkyu Hokoku, No. 26, p 45-57, 1978. 1 fig, 5 tab, 5 ref.

The physical characteristics of a sandy loam soil were examined after additions of 1-4% powdered surplus sewage sludge. The initial bulk density of the soil was 1.40 g/cu cm; the 13 sludge bulk densities ranged 0.22-0.77 g/cu cm. The bulk density of the 1% sludge-soil mixtures ranged 1.35-143 g/cu cm; bulk density usually decreased after sludge additions. Increased bulk density was attributed to the fine particle size of some of the sludges. When the soil-sludge mixtures were saturated with water, a linear relationship between the evaporation and the duration period was established during the first 13 days, followed by a curvilinear relationship during the next 13-32 days. Sludge additions did not control evaporation from the soil. The capillary-rise time to the surface for the soil alone was 8 min; 1% sludge additions increased the rise time to 10-85 min. The water capacity of the soil, initially 38.2%, ranged from 33.2-41.0% when 1% sludge was added; capacity was related to the particle size and shape and the wetting resistance of the sludges. Insoluble aggregate formation in the mixture increased from 5.1% to 5.4-7.8% after 9 mos of repeated wetting and drying; aggregate formation also improved after wheat cultivation. The permeabilities of the sludge-soil mixtures were lower than that of soil alone.

D515

FEASIBILITY OF THE USE OF HYDROGEN PEROXIDE IN OVERLOADED WASTE-WATER PURIFYING PLANTS (Moznosti vyuziti peroxidu vodiku v pretizenych cistirnach odpadnich vod),

Cerny, J. K.

Krajska Hygienicka Stanice Stredoceskeho Kraje,
Prague, Czechoslovakia.

Ceskoslovenska Hygiena, Vol. 22, No. 10, p 474-480, 1977. 4 tab, 4 ref.

Hydrogen peroxide was tested as an additional source of oxygen in waste water aeration treatment tanks during laboratory tests and in an overloaded plant treating waste water from a medical facility for tuberculosis and respiratory diseases. The results indicated that 1 kg oxygen could be added to the waste water for each 7.5 liter addition of a 40% hydrogen peroxide solution. The addition of hydrogen peroxide enhanced the activity and composition of the activated sludge organisms. Metered additions of hydrogen peroxide were considered economically feasible in the event of treatment plant overloading or aeration equipment failure. There were problems associated with the handling of the caustic hydrogen peroxide.

D516
OZONE GIVES WASTE WATER THE TREATMENT,

Chemical Week, Vol. 122, No. 25, p 49, June, 1978.

The use of ozone for water and waste water treatment in the United States is increasing, with the largest current application being the 30 mgd waste treatment plant in Springfield, Missouri. Major suppliers of ozone-producing equipment in the United States include Emery Industries, Union Carbide, Crane, Wellsbach, PCI, Trailigaz, and Degremont. Several current projects and contracts anticipated by these suppliers are described, including waste water treatment plants in: Meander, Ohio; Olympia, Washington; Indianapolis, Indiana; Tacoma, Washington; and Cleveland, Ohio. Cleveland's Westerly plant has used ozone-generating equipment supplied by Emery for disinfection, as well as to enhance tertiary treatment with activated carbon. EPA-sponsored pilot studies in several cities are currently testing the feasibility of activated carbon-ozone treatment for potable water. Additional EPA studies have examined dosage requirements for high level disinfection and compared costs for ozonation and chlorination.

D517
TOWN ABANDONS TERTIARY SEWAGE PLANT,

Engineering News-Record, Vol. 201, No. 1, p 11, July, 1978.

Moosehead, Maine, Sanitary District's three-year-old tertiary treatment plant in Greenville will be replaced by a secondary effluent land application treatment system. The 250,000 gpd tertiary plant cost $4.3 million to construct; annual estimated operation and maintenance costs of $28,000 increased to $125,000 due to overtime paid to employees attempting to fix the sand filters. The upper 6 inches of the third stage 5 ft-long sand filters had clogged repeatedly with secondary effluent. Polymers could not alleviate the clogging problem and effluent was bypassed. Chemical treatment was applied directly to the final clarifiers. The proposed $2.5 million land application system will spray 80 acres of private woodlands with secondary effluent.

D518
STALLED SLUDGE TALKS SPUR COURT ORDER,

Engineering News-Record, Vol. 201, No. 4, p 19, July, 1978.

The District of Columbia has been ordered by the federal district courts to construct a sludge composting plant to treat the 850 tons/day of wet sludge produced by Washington and three other counties. The city has claimed that a composting facility will produce particulate emissions exceeding federal limits and release a lung disease-related fungus that would present a health hazard to patients in a nursing home 2,000 ft from the site. EPA has reported that no data has yet been presented to support these claims. The sludge is currently transported to the three countires for burial, composting, or land application; negotiations had centered on the ultimate location for disposal of the sludge. The $2 million composting facility will be constructed at Washington's Blue Plains waste water treatment plant.

D519
SMART SHOPPERS CUT COST OF TREATMENT PLANT,

Engineering News-Record, Vol. 201, No. 4, p 24, 28-29, July, 1978.

The division of a $364 million waste water treatment plant construction project into 18 separate contracts has saved an estimated $50 million. Construction of the Passaic Valley, New Jersey, plant is under the supervision of Charles A. Manganaro Consulting Engineers of New York City who staggered the bid dates of 11 of the contracts over an 11-mo period to take advantage of market fluctuations. The first phase of the project, a 300 mgd computerized pure oxygen-activated sludge system, is being constructed on timber piles and 60 ton concrete shell piles, driven 30-60 ft into a swampy site 10 ft above sea level. Oxygen injections of 600 tons/day will treat mixed municipal and industrial effluent with BOD and suspended solids loads of 400 ppm. A five mile 12-ft diameter outfall discharging waste water into New York Harbor will be converted from a gravity flow line to a pumped system. The second stage of the project, still under design, will include upgrading and some new construction for the primary treatment system.

D520

THE FILTER BELT PRESS-APPLICATION AND DESIGN,

Austin, E. P.

Simon-Hartley Limited,
Stoke-on-Trent, England.

Filtration and Separation, Vol. 15, No. 4, p 320, 324, 326, 329-330, July/August, 1978. 4 fig, 1 tab.

The design and application of filter belt presses are described for sludge dewatering. Free water within organic sludge is removed by gravity dewatering to produce a sludge containing 10% solids; intercellular water, chemically bonded around the sludge particles, is removed by chemically conditioning with a polyelectrolyte. Intracellular water within the biomass cells is expensive to remove and contributes to a higher BOD load. Compaction dewatering is usually accomplished on monofilament polyester filter belts, with small length-to-width ratios. The selection of filter belts, with tensile warp strengths ranging 140-280 kg/cm, depends upon the mechanical strength of the filter press machinery, the sludge characteristics, and the desired degree of dewatering. Municipal sludges can be dewatered to 20-45% solids; dewatering is enhanced by the ash content of the sludge. The range of polyelectrolyte dosages is larger for sludges with lower feed solids concentrations, such as oxidation ditch and activated sludges; stable digested sludges accommodate a much narrower range of optimum polyelectrolyte dosages.

D521

INFILTRATION THROUGH SOIL AS A TERTIARY TREATMENT OF SEWAGE EFFLUENT,

Childs, C. W., Searle, P. L., and Wells, N.

Soil Bureau, Department of Scientific and Industrial Research,
Lower Hutt, New Zealand.

New Zealand Journal of Science, Vol. 20, No. 4, p 433-437, December, 1977. 1 fig, 5 tab, 4 ref.

Infiltration of secondary effluent through ten 50-cm core soil samples from North Island, New Zealand, was used to investigate the effectiveness of the soils in tertiary treatment of municipal sewage. The soils included three silt loams, a stony loam, clay, two sandy loams, sand, sandy silt, and peat. The soil columns, with vegetation intact, were irrigated for 10 mos with tap water or secondary effluent at a rate of 55 mm/week during the warmer months and 27.5 mm/wk during winter months; the soils were also flooded weekly for 24 hrs during a 5-mo test period. Leachates were analyzed for Na, K, Mg, Ca, Mn, Al, Fe, ammonium-N, nitrate-N, kjeldahl-N, total-P, F, and coliforms. The Otorohanga silt loam and the Taupo sandy silt produced leachates with 2.0 mg/liter or less total-N and 0.07 mg/liter or less total-P under systematic irrigation and flooding conditions. These soils also consistently achieved the lowest coliform counts. The dry weight of the pasture vegetation on all columns treated with effluent was nearly double the weight of plants watered with tap water.

D522
SUBMERSIBLE SEWAGE PUMPS,

Pollution Engineering, Vol. 10, No. 6, p 95, June, 1978.

The Hyr-O Pumps Division of Wylain, Inc. has developed a new line of non-clog submersible sewage pumps. The 4-inch S4N Series pumps were designed for high efficiency wet well pumping in the intermediate range and lower capital costs. The units have the capacity to pump grease, dirt, raw sewage, and solids up to 3 inches in diameter. The S4N Series accommodates capacities up to 580 gal/min with head sizes up to 56 ft. The two-vaned impeller is constructed of cast iron and balanced to ensure clog-free, quiet, vibrationless performance. The pumps are suitable for liquids with pH values in the range of 6-9; the submersible units can also accommodate specific gravities in the 0.9-1.1 range and viscosities in the range of 28-35 Saybolt seconds universal.

D523
DISPOSAL OF AEROBICALLY DIGESTED SLUDGE,

Watenburger, T.

Little Blue Valley Interim Treatment Plant,
Independence, Missouri.

Public Works, Vol. 109, No. 7, p 70, July, 1978.

Four Model 80 sludge concentrators, manufactured by Ecodyne Corp.'s Smith and Loveless Division, were installed at the Little Blue Valley Interim Treatment Plant in Independence, Missouri, to dewater the large quantities of sludge produced in the aerobic digester. The 20 mgd capacity interim plant treats an average of 16 mgd of waste water in two combined aeration/settlement basins, an aerobic digester, and six sand filters; the final effluent contains about 5 mg/liter BOD and 2 mg/liter suspended solids. The concentrators process 13,000-25,000 gal/day of a thickened slurry with a 49-50% organic load and 4% solids content. The sludge is treated with a cationic polymer, flash mixed, and concentrated by gravity and pressure processes to 14.5% solids content. Gravity dewatering is performed on continuous, variable speed open-mesh filter screens; three sets of compression rollers further dewater the sludge in the pressure stage. The dewatered cake is pumped to a truck for removal to land application sites.

D524
WASTE-WATER CENTRIFUGAL DECANTERS FOR SEWAGE TREATMENT PLANTS,

Sulzer Technical Review, Vol. 50, No. 4, p 179, 1978.

The ZDA series of municipal waste water centrifugal decanters, manufactured by Escher Wyss, offers minimal flocculant consumption with optimum concentrate purification. The decanter produces a dewatered sewage sludge that is suitable for direct storage or application to agricultural land as an organic fertilizer. The dewatered sludge may also be dried further and incinerated. Rotor diameters of 360, 500, 630 mm are available; the ZDA-50 model has a maximum nominal capacity of 18 cu m/hr. Escher Wyss can supply the centrifugal decanters with adjustable, fixed, or in-service controllable speeds to operate the solids discharge screw. The centrifugal decanters are also suitable for chemical and mining industrial applications.

D525
HYGIENIZATION OF SEWAGE SLUDGE WITH ELECTRON BEAMS,

Sulzer Technical Review, Vol. 50, No. 4, p 179, 1977. 1 fig.

The Sulzer electron beam-hygienization plant for disinfection of sewage sludge employs an electron accelerator and scanner system, in addition to a sludge supply, dosing, and regulating system. Electron beams, emitted from an electron source with a heated cathode, are fine and tightly packed with low energy. The electrons gain maximum energy as they pass through an accelerator in a vacuum. A scanner system containing a thin titanium foil strip is used to deflect the electron beam by an alternating magnetic field to adapt the beam to the width of the sludge. A sludge dosing system continuously distributes a preset amount of sludge onto a conveyor roller at a thickness suitable for electron beam penetration. The electrons are braked as they come into contact with the 2,000 mm width of the sludge on the conveyor roller. Throughput speed is determined by the beam current; throughput quantity is controlled by the sludge thickness and width, and the roller rotation speed.

D526
EDINBURGH SINKS (POUNDS STERLING)35M IN UNDER CITY AND SEA SEWERAGE,

Paynting, T.

Surveyor,
Sutton, Surrey, England.

Surveyor, Vol. 4481, No. 151, p 17-18, April, 1978.

Edinburgh, Scotland's, 35 million pounds sterling sewage treatment project included the construction of a 55 mgd primary treatment plant, 8.4 km of interceptor lines, and a 2.8 km long outfall sewer. The treatment facility, with an ultimate design capacity of 74 mgd, was constructed on a stone graded foundation enclosed by a sheet-piled cofferdam. The plant has triple feed channels, bar screens, a feed conveyor belt to the screenings press, detritor tanks, and four 55 m-diameter sedimentation tanks. Interceptor sewers with diameters of 3,124 mm and 2,290 mm connect to the older sewers and have provisions for automatic storm overflow control. The outfall sewer was constructed in an undersea tunnel with a treatment plant access point located 52 m below the surface. The tunnel diminishes in diameter from 3.6 m to 0.9 m; it is equipped with 20 diffuser pipes located along the outer 760 m. Sewage sludge is discharged 16 km offshore by a specially designed vessel with a sludge capacity of 2,500 tons.

D527

NINE PUMP INSTALLATION FOR WESSEX WATER AUTHORITY,

Water Services, Vol. 82, No. 987, p 293-294, May, 1978.

Nine New Haden pumps, installed at the Kinson Sewage Disposal Works in Wessex, England, can accommodate a flow rate of 10,800 cu m/day. Three type 37 unchokeable pumps with 15 hp, 960 rpm motors can each pump 216 cu m/hr of raw unscreened sewage at the sewage works inlet. They are equipped with single channel or double unchokeable impellers and pump against a total head of 8.15 m. Two type 36 semi-unchokeable pumps equipped with double channel shrouded impellers are used to move sludge from humus tanks to the sewage works inlet at a rate of 108 cu m/hr. These pumps have 10 hp, 1450 rpm motors that operate against a head of 13.37 m. Four type 36 semi-unchokeable pumps recirculate waste water to rotary bed filters. Each pump is equipped with a 15 hp, 960 rpm motor, operating at a rate of 234 cu m/hr against a head of 7.6 m.

D528

PLANT TO DISINFECT WASTEWATER WITH OZONE,

Allen, R. K., and Oblas, V. C.

Water and Sewage Works, Vol. 125, No. 7, p 48-53, July, 1978. 4 fig, 2 tab.

A $38 million regional project in Washington includes separation of storm and sanitary sewers and construction of the 13.9 mgd LOTT secondary treatment plant. The plant will utilize an equalization basin, a high-purity oxygen activated sludge system, and an ozone disinfection system to accommodate a BOD loading of 13,744 kg/day, an equalized flow of 35 mgd, and a maximum flow for partial treatment of 137 mgd. Space limitations at the existing site and the need to improve the quality of receiving waters provided additional impetus for selecting the ozone/oxygen process. Prior to design finalization, three modes of ozone-oxygen treatment were tested: air-fed, oxygen-fed once-through, and oxygen-fed recycle. Comparisons of the oxygen-fed systems according to process performance, control complexity, power requirements, track record, and current technology led to the selection of the once-through mode of operation for LOTT. Ozone generation will be controlled by the waste water flow and the oxygenation basin line pressure. Design specifications for LOTT's ozonation basin include: two contact chambers; an ozone dosage of 10 mg/liter; a detention time of 16 min; a 5.8 m-deep vertical baffled tank; tubular fine bubble diffusion equipment, submerged to 4.88 m; and a diffuser pore size of 60 microns. Bid specifications for the ozone generation equipment are designed to give consideration to capital cost, power efficiency, and heat recovery capability.

D529
SECONDARY CLARIFIER WITH A DIFFERENCE,

Consulting Engineer, Vol. 42, No. 7, p 41, July, 1978.

The Rim Flo secondary clarifier is equipped with both feed and decanting channels at the periphery of the tank and a suction header sludge removal unit. The clarifier was designed by Envirex Inc. and is distributed in England by Paterson Candy International. The design of the clarifier reportedly permits greater waste water volumes, higher overflow rates, maximum hydraulic stability, full surface skimming, and lower construction costs than conventional clarifiers with central feed well units. Clarifiers that have been converted to the peripheral channel configuration have accommodated greater volumes without tank expansion. The Rim Flo is also equipped with a rotary suction tube containing specifically sized and spaced outlets for sludge removal. The central shaft of the rectangular, tapered suction tube runs parallel to the base of the clarifier and can remove low density sludges or provide rapid sludge removal.

D530
DEEP SHAFT,

Consulting Engineer, Vol. 42, No. 7, p 43, July, 1978.

The deep shaft biological treatment system installed in England's Marsh Farms treatment plant treats both industrial and municipal wastes. The high chloride content of the waste water required that the 130 m deep shaft unit's downcomer be constructed of corrosion-resistant fiberglass-reinforced plastic. The deep shaft is 2 m in diameter, with a large bell-mouthed T-piece to distribute waste water to the downcomer. The downcomer hangs freely in the shaft and is constructed to withstand 30 yrs of service; the downcomer must have high mechanical strength and precision alignment in the shaft for efficient waste water treatment.

D531
PREFAB PUMPING STATIONS,

Consulting Engineer, Vol. 42, No. 7, p 43, July, 1978.

Sweden's Pumpex AB has designed a range of prefabricated sewage pumping stations with capacities rated up to 75 liters/sec. The pumping stations are supplied completely equipped in diameters of 2-2.5 m and heights of 2.2-5.2 m to accommodate the design depths of mains. The fiberglass-reinforced polyester tanks are equipped with pumps, pipework, valves, control system, and ladder. Installation comprises bolting the station to a concrete platform laid at the base of an excavation; the station is then connected to the inlet and outlet of the pumping main and to a power supply. Motor units may be removed and pump volutes may be attached through a steel plate at the base of the station. The stations may be purchased with options such as a radiator, platforms, lighting, and water heater; prices for the pumping stations start at 2,000 pounds sterling.

D532
ELECTROLYTIC DISINFECTION,

Consulting Engineer, Vol. 42, No. 7, p 41, 43, July, 1978.

An electrolytically-produced hypochlorite solution, derived from sea water, is used to disinfect sewage from the English Channel island of Guernsey. The hypochlorite solution is obtained by passing sea water through a 3 mm gap between a platinized titanium anode and a mild steel cathode contained in two pairs of enclosed glass fiber electrolytic cells. Waste water from cesspools is treated at the rate of 7,000 gal/hr by treatment with ferric oxide for hydrogen sulfide removal, followed by metered treatment with the hypochlorite solution. The hypochlorite reduces bacillus coli in the sewage by 99.9%; the waste water is then screened, pumped to two 5,000 gal reactor tanks, agitated, and discharged to the outfall sewer. Power costs for pumping equipment and electrolysis were about 245 pounds sterling for one month; a similar treatment plant has been constructed at the island's Bellegreve outfall at Saint Peter Port. The treatment system replaced direct discharge of sewage through an outfall sewer to the sea.

D533
FLUIDIZATION TREATMENT PROCESS TO BE TRIED,

Consulting Engineer, Vol. 42, No. 7, p 41, July, 1978.

The Oxitron biological treatment system, developed by Ecolotrol Inc. of New York and distributed by Dorr-Oliver, provides nitrification and denitrification of waste water. The Oxitron system consists of a reactor filled with a biomass support media, such as sand, that is expanded to more than twice its compacted size. The waste water is introduced upwards into the media at a rate sufficient to maintain fluidization of the media. The large surface area of the fluidized bed provides a higher concentration of active biomass, including bacteria and higher-order microorganisms. This higher concentration reportedly permits higher hydraulic loading rates during biological carbonaceous BOD removal.

D534
FLUID TREATMENT WITH PLASTICS PASTA,

Consulting Engineer, Vol. 42, No. 7, p 40-41, July, 1978.

Acalor International Ltd. has designed Biofil, an injection molded filter medium for percolating or trickling filters, absorption towers, and gas scrubbing systems. The spherical Biofil medium has triangular faces, a configuration that contributes to the strength of the material. The triangular faces are outlined by two serrated-edged fins which provide a more functional surface area. The serrated edges interlock, providing greater stability to the packed bed, and allow for random packing of the media. Biofil promotes even contact time and uniform distribution of the waste water through a series of planes. The use of Biofil media can reduce filter construction costs and size.

D535
ADVANCED WASTEWATER TREATMENT PLANT GAINS CARBON REGENERATION FURNACE,

Consulting Engineer, Vol. 42, No. 7, p 40, July, 1978.

A 7-hearth activated carbon regeneration furnace has been installed in the Coleshill, England, advanced waste water treatment plant, under the jurisdiction of the Severn-Trent Water Authority. The furnace is constructed of a mild steel, 5 m-high stack lined with refractory blocks; a variable speed shaft drives a rotating nickel-chrome rabble arm unit in each 1.5 m diameter hearth to agitate the carbon as it falls through the hearth floor gratings. The carbon is dried by five burners and an electrical fan supplying combustion air at a rate of 5.6 cu m/min. The burners, conveyors, and motors are individually controlled and monitored with ultra-violet detection. Plant operating conditions are continuously monitored in the main plant control room and plant malfunction data is conveyed by remote signalling to an alarm system in the control room. Steam is generated on-site and injected at 54 kg/hr into five of the hearths. Waste gases are saturated with water and passed through a two-stage scrubbing unit before returning to the furnace stack.

D536
EFFECTS OF ORGANIC FRACTIONS FROM SECONDARY EFFLUENT ON SELENASTRUM CAPRICORNUTUM (KUTZ),

Sachdev, D. R., and Clesceri, N. L.

Envirosphere Company,
New York, New York.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1810-1820, July, 1978. 8 tab, 26 ref.

The maximum specific growth rate and the maximum standing crop of Selenastrum capricornutum were measured in studies using effluent organic fractions of varying molecular weight. Filtered effluent from a trickling filter plant and a stabilization pond was concentrated and the organic components were separated on Sephadex Gels G-10 into the apparent molecular weight (AMW) fractions of 0-700 AMW, 0-1,500 AMW, and 1,000-5,000 AMW. In the >700 AMW fractions, the organic carbon content ranged 200.0-780.0 mg/liter; in fractions with <700 AMW, the phosphorus level was 0.0003-0.064 mg/liter, and the nitrogen concentration 0.0005-2.29 mg/liter. Organic fractions were added to 100 ml of an S. capricornutum-bearing algal assay medium in doses that simulated the concentration of the original effluent. Both effluents stimulated maximum specific growth rates of the algae; only the stabilization pond effluent had an impact on the standing crop of algae. Organic fractions with AMW >700 stimulated both the maximum specific growth rate and the standing crop of S. capricornutum; growth stimulation was attributed to organic components and not to inorganic carbon or the supplemental nitrogen or phosphorus additions. The organic compounds were not considered to be chelating agents in the experiments because of the medium composition, although their role as chelating agents in a natural aquatic environment was considered feasible.

D537
UPGRADING STABILIZATION POND EFFLUENT BY WATER HYACINTH CULTURE,

Dinges, R.

Wastewater Technology and Surveillance Division,
Texas Department of Health,
Austin.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 833-845, May, 1978. 6 fig, 10 tab, 15 ref.

Treatment of stabilization pond effluent was investigated with water hyacinths (Eichhornia crassipes) grown in a four-sectioned 585 sq m tank at the Williamson Creek Waste Water Treatment plant in Austin, Texas. The water hyacinths reduced volatile suspended solids by an average of 93%, chlorophyll-a by 93%, fecal coliforms by 98%, BOD by 87% to less than 10 mg/liter, and nitrogen by 63% to less than 5 mg/liter. The leaves and stems of the water hyacinths exhibited high accumulations of phosphate, potassium, chloride, magnesium, and iron; the plants also accumulated arsenic, chromium, mercury, lead, nickel, zinc, copper, and manganese. Small basin design, in the range of 4,000 sq m with a 1-m depth, was considered more efficient for treating about 0.3 mgd of stabilization pond effluent. Incorporating rapid and effective drainage means into the design of the hyacinth ponds was also recommended.

D538

SLUDGE DEWATERING STUDIES AT HYPERION TREATMENT PLANT,

Ohara, G. T., Raksit, S. K., and Olson, D. R.

Bureau of Sanitation,
Los Angeles, California.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 912-925, May, 1978. 9 fig, 9 tab.

The Los Angeles Bureau of Sanitation investigated sludge treatment and dewatering techniques as an alternative to ocean disposal of the 150 tons sludge with a solids content of 2.5% produced daily. Pilot plant studies covered solid-bowl centrifugation, basket centrifugation, vacuum filtration, drying beds, and pressure filtration. Physical, chemical, and thermal conditioning techniques of sludge treatment were also studied. The most suitable methods were identified by the study as: drying bed or evaporation pond dewatering of chemically-conditioned sludge; solid-bowl centrifugation of chemically-conditioned, thermophilically digested sludge; and basket centrifugation of chemically-conditioned, mesophilically digested sludge. The latter two treatment processes cost $41.40 and $39.50/ton dry solids, respectively, while drying bed treatment cost $22.40/ton dry solids, excluding the cost of required land.

D539

LAND TREATMENT OF WASTEWATER AS AN INNOVATIVE OR ALTERNATIVE TECHNOLOGY,

Hadeed, S. J.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1709-1712, July, 1978. 1 fig.

The 1977 Clean Water Act gives consideration to innovative and alternative waste water treatment processes. The act considers unconventional projects with total costs 15% more than the most cost-effective conventional projects as competitive; thus, grant eligibility would be extended to innovative projects with higher costs. These novel systems are defined as resource recovery processes, such as land application, water reuse, and energy recovery. Other criteria require: that the energy costs be 20% less than those required for the most cost-effective conventional system; that the process be relatively safe from upset and operational malfunctions; that toxins management be improved; that the project conserve water, land, and resources; and that methods incorporate treatment of both municipal and industrial wastes. Land application alternatives include overland flow, infiltration-percolation, and spray irrigation. The 28 mgd Muskegon, Michigan, biological treatment facility applies secondary effluent to corn crops by spray irrigation. While the facility has realized a 60% operating cost reduction from corn crop revenues, criticism has been directed at the site location, the potential groundwater contamination, the design of the storage lagoons, and the results of pilot plant tests. The act also requires that construction materials and treatment equipment be manufactured in the United States.

D540

REGIONAL WASTEWATER TREATMENT SYSTEMS IN JAPAN,

Brill, E. D., Jr., and Nakamura, M.

Illinois University,
Urbana-Champaign,
Institute for Environmental Studies.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1715-1726, July, 1978. 4 fig, 5 tab, 29 ref.

Planning and implementation of regional waste water treatment facilities were surveyed in Japan. Japan's urban area has more than doubled since 1963 and the population served by drainage has increased from 7.4 to 22.6%; between 1976-1980 Japan is expected to spend $25 billion for sewerage. Prefectural governments in Japan are currently conducting a comprehensive regional planning program to design and implement waste water treatment facilities and sewerage projects. Waste water treatment planning in Japan encompasses a study of historical and cultural frameworks, short-run economies of scale, short-run effectiveness, and long and short-run flexibility. Other factors considered in comprehensive regional planning include drainage, water supply, and land use; the prefectural governments are responsible for planning projects, with the cooperation of the community; they also own and operate central facilities and interceptors. Although local communities do not directly participate in the regional planning projects, a program for the dissemination of public information provides public hearings, meetings, and tours of completed facilities.

D541

SLUDGE DEWATERING WITH CENTRIFUGES,

Water Services, Vol. 82, No. 989, p 399, July, 1978.

KHD Industrieanlagen AG manufactures three types of solid bowl and screen centrifuges for dewatering sewage sludges. Solid bowl centrifuges, operating on the co-current principle, dewater sludges at throughput rates up to 120 cu m/hr when the rotor and screw speeds match the feed rate. The feed point is located in front of the drum's solid rear wall; this configuration allows for a settling zone in proximity to the feed point. Septic tank size at treatment facilities can be reduced when the centrifuge precedes the tank, reducing the quantity of sludge to be treated; centrifuges located after the tanks further reduce sludge. Besides primary dewatering, the centrifuges dewater digested sludges for storing or recycling. The solid bowl centrifuges can operate efficiently at low feed concentrations and provide extended settling durations for minute particle removal and improved solids compaction.

D542

FILTRATION MEDIA FOR SEWAGE APPLICATIONS,

Water Services, Vol. 82, No. 989, p 422, July, 1978.

Webron Products Ltd. of Rossendale, Lancashire, England, has introduced the Hydron needle felt wet filtration fabric. The fabric, which is used as a cover on rotary drums, has been pretested in filter presses and rotary drum filtration plants for dewatering digested sewage sludges. Results of the testing indicate that the Hydron product has a high liquid throughput rate and a long working life; it is also capable of producing a high quality filtrate and high solids content sludge cake. Filter press investigations have demonstrated that needle felt media provide high flow rates through the pore structure, shorter batch cycle time, and easy release of the sludge cake. The Hydron fabric, which is suitable for use with diatomaceous earth and activated carbon, is available in filtration grades ranging from coarse for sewage sludge to fine for particulate removal and clarification.

D543

TURNING SLUDGE INTO SOIL CONDITIONER SOLVED A CITY'S DISPOSAL PROBLEM,

Senske, F., and Lauletta, T.

Philadelphia Water Department,
Water Pollution Control Division,
Pennsylvania.

Water and Sewage Works, Vol. 125, No. 7, p 24-26, July, 1978. 2 tab.

As an alternative to ocean disposal, sewage sludge from Philadelphia, Pennsylvania, is anaerobically composted, cured, shredded, and given to the public as a soil amendment. Philorganic has a solids content of 60-70%, about 17,000 mg/kg phosphorus, 9,700 mg/kg Kjeldahl nitrogen, 12,100 mg/kg iron, 3,900 mg/kg potassium, and quantities of mercury, cadmium, chromium, copper, lead, manganese, nickel, zinc, potassium, arsenic, vanadium, selenium, and beryllium. Sludge excavated from storage lagoons, containing about 25% solids, is spread in an 8-inch layer, harrowed with an agricultural disc, and scraped into containers; the process requires about 4 wks and produces a sludge containing about 60% solids. The addition of a cleated-belt conveyor shedding unit with a 125 cu yd/hr input capacity produced a more uniform and spreadable product. Fresh sludge is anaerobically composted for 21 days, cured for 20 days, and transported to the shredder for Philorganic production. The shredder automatically removes foreign debris from the sludge and recovers up to 50% of the wood chips being tested as a bulking agent.

D544

EFFECTIVENESS OF BACKWASHING FOR WASTEWATER FILTERS,

Cleasby, J. L., and Lorence, J. C.

Iowa State University,
Ames,
Department of Civil Engineering and Engineering Research Institute.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE4, p 749-765, August, 1978. 3 fig, 6 tab, 6 ref.

A four-year study of backwashing practices suitable for municipal trickling filters has concluded that single media filters are most effectively washed by simultaneous air scour and subfluidization backwash. Water fluidization, air scour prior to water fluidization, and surface wash and subsurface wash before and during fluidization backwash were tested on three pilot-scale trickling filters packed with single, dual, or mixed media to treat secondary effluent. Single medium filters containing coarse sand had bed depths of 24-60 inches; the total depth of the dual coal and sand filter was 24 inches; the tri-media coal, sand, and garnet filter was 27 inches deep. Air scour or surface wash was considered essential for proper performance of filter beds within these depth ranges; these practices, in conjunction with water fluidization backwashing, were considered feasible but not optimum for all filter types tested. Separate backwashing of three coarse sand filters with different depths demonstrated that the initial 8 gal/min/sq ft backwash flow rate utilized during simultaneous air-water wash and water wash alone was insufficient; increasing the water flow rate to 15 gal/min/sq ft at an air flow rate of 8 cu ft/min/sq ft immediately improved media condition. A 12-15 inch bottom layer of media remained dirty; provisions were recommended for preventing the loss of filter media during backwashing.

D545
TREATMENT OF PRIMARY SEWAGE SLUDGE WITH ENZYMES,

Knapp, J. S., and Howell, J. A.

Swansea University College,
Wales,
Department of Chemical Engineering.

Biotechnology and Bioengineering, Vol. 20, No. 8, p 1221-1234, 1978. 7 fig, 19 ref.

Cellulolysis of primary sewage sludge with an enzyme isolated from Trichoderma viride did not improve the filterability of sludge but did improve the settling characteristics of very dilute sludges. The cellulase preparation was obtained by removing the mycelium from a submerged culture of T. viride. One ml of the enzyme preparation was mixed with 39 ml of primary sewage sludge in all but one experiment where larger volumes were used. The specific resistance to filtration (SRTF) of the cellulase-treated sludges increased sharply within the initial 4-6 hrs of treatment. In some cases, the SRTF gradually returned to that of untreated sludge, while other sludge samples did not regain their original filtration properties even after 24 hrs of treatment. A 30-fold increase occurred in the settling rate of cellulase-treated dilute sludge containing 6 g/liter suspended solids. Settling doubled in treated sludge containing 20-25 g/liter solids. Cellulolysis tripled the settling rate at 50 g/liter solids but only increased the solids concentration by 30%. The protein concentration of the filtrate from the treated sludge increased 5-10 fold, up to 2.4 g/liter protein, and the BOD increased up to 13,000 mg/liter; the filtrate was capable of supporting the growth of yeasts, such as Candida utilis, for the production of single cell protein. The productivity, however, was low and the process was not considered economically feasible at this time.

D546
PURE OXYGEN FIXED FILM REACTOR,

Yeh, S-J., and Jenkins, C. R.

Reid, Quebe, Allison, Wilcox and Associates, Incorporated,
Indianapolis, Indiana.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE4, p 611-623, August, 1978. 6 fig, 4 tab, 20 ref.

Laboratory tests were performed on a continuous-flow aerobic media trickling filter which supplies pure oxygen to the biomass through pressurized, thin capillary walls of Teflon. The studies concluded that the process was capable of accomodating higher organic loads than conventional trickling filters or activated sludge processes. The bench-scale reactor consisted of a 51-mm internal diameter, 1.7-m long Plexiglass pipe containing etched Teflon tubes with wall thicknesses of 0.33 mm, 0.79 mm, and 0.23 mm; upstream tube ends were attached to an oxygen inlet manifold, while the downstream ends were sealed. A synthetic waste water feed, with a BOD concentration of about 200 mg/liter and a pH of 6.15-7.00, was varied according to total organic carbon content over 55, 110, and 165 mg/liter; detention time in the reactor was maintained at 0.5, 1.0, 2.0, and 3.0 hrs for each organic loading. The organic removal efficiency in the reactor increased with detention time, reaching a plateau after about 1 hr at the lowest organic loading; for the other organic carbon concentrations, 2 hrs was considered the optimum detention time for 90% removal. Yield coefficients, dependent upon detention time in the aerobic media filter, were not as high as those of conventional or oxygen activated sludge processes, but were comparable to those in high rate trickling filters. Although nitrification occurred along the length of the reactor, the rate decreased as the reactor length increased because of localized denitrification, inhibitory conditions, washout of nitrifying populations, and low ammonia concentrations. The oxygen demand for the filter system ranged over 1.4-2.27 lbs O2/lb BOD removed, similar to the demand of an oxygen activated sludge system.

D547
CITY OF HAMILTON WATER POLLUTION CONTROL PLANT,

Steven, D. L.

Steven and Fitzmaurice,
Christchurch, New Zealand.

New Zealand Engineering, Vol. 33, No. 6, p 122-126, June, 1978. 2 fig, 2 ref.

The first stage in a three-stage project to develop a municipal waste water treatment plant in Hamilton, New Zealand, involved the construction of primary treatment and chlorination facilities to accommodate an average dry weather flow of 45,500 cu m and installation of a 2,400 mm subfluvial outfall into the Waikato River. The second and third stage plans include the construction of secondary treatment facilities to increase the treatment capacity to 57,000 cu m and doubling the size of both primary and secondary facilities. Sewage flows by gravity through a 1,650 mm reinforced-concrete pipeline to the plant where it is passed through three bar screens each 1,800 mm wide. Screened sewage passes through a standing wave hydraulic control flume and aerated concrete conduits to the grit removal and aeration tanks where it is subjected to about 30 min of aeration at a rate of 0.4 cu m/min/meter tank length. Grit and settled particles are transferred from the tank bottom to hoppers for subsequent cyclone dewatering. Following preaeration, the waste water receives primary settling for about 2.2 hrs in three reinforced-concrete tanks equipped with sludge removal pumps and air jets for removal of surface grease, fat, and scum. Sodium hypochlorite is produced on-site by electrolysis of a brine solution; the waste water is chlorinated in the subfluvial outfall which also acts as a contact basin. The facility also contains two reinforced-concrete sludge digesters and a foul air reclamation system.

D548
TERTIARY TREATMENT OF EFFLUENTS BY FILTRATION,

Schmidt-Holthausen, H. J.

Schumacher'sche Fabrik,
Bietigheim, West Germany.

Filtration and Separation, Vol. 15, No. 4, p 350, 352, 367, July-August, 1978. 1 fig, 1 tab.

Separating layer filtration, sand filtration, and multi-layer filtration are evaluated as tertiary treatment methods for municipal waste water. Separating layer filtration, utilizing porous media, requires precoating of the filter layer with diatomite or perlite to prevent waste accumulation and filter clogging. Precoating of the filter medium can increase the surface filtration area within a small space, reduce backwash water and compressed air requirements for filter cleaning because of a fairly dry solid residue, and provide a chemical reagent for additional treatment of resistant materials. Incorporating waterproof membranes between the filter layers enhances solids removal. During tertiary treatment, sand filtration requires two or more layers for adequate sludge retention. Tests have indicated that high performance with low resistance and maximum solids deposition can be achieved with a filter containing equal volumes of 1.5-2.5 mm hydro-anthracite and 0.7-1.2 mm quartz sand. A new highly porous media, Hydro-Multifilt, can be arranged in 400-600 mm layer thicknesses without upper layer stratification of fine particles. The round granules have a bulk density of about 640 kg/cu m and an apparent density of approximately 1.03 g/ml. Upflow rather than downflow filtration through a multi-layer filter is not considered as efficient because of the reduced filtration speed and potential breakthrough.

D549
AERATED-PILE COMPOSTING: A PROMISING NEW ALTERNATIVE FOR DISPOSING OF SEWAGE SLUDGE,

Dallaire, G.

Civil Engineering-ASCE, Vol. 48, No. 9, p 110-117, September, 1978. 3 fig, 3 tab, 10 ref.

The United States Department of Agriculture's research center in Beltsville, Maryland, has developed an aerated-pile composting technique for digesting raw sewage sludge. The raw sludge is initially dewatered to about 22% solids with a centrifuge, belt filter press, or vacuum filter; the solids content is further increased by mixing the sludge with woodchips. The mixture is then applied to a bed of woodchips which cover a suction aeration system. The compost pile is covered with a 1-ft insulating blanket of woodchips or compost. The aeration system draws air, heat, and moisture down through the compost pile to the suction pipe system. Within the first 3-5 days of composting, internal temperatures reach 80 C, sufficient for destroying most pathogens.

After 21 days of composting, the material is spread in thin layers or in windrows for drying. The compost may also be piled, unaerated, for 30 days of curing if inclement weather conditions exist. If the compost is dried, the material is then screened to remove the woodchips and cured for 30 days; if the compost is initially cured, the material is then dried and screened. The use of aerated extended piles, in which piles are placed adjacent to one another and covered with a continuous layer of insulation, can reduce expenditures for land and woodchips. High heavy metal concentrations, especially cadmium, in the compost may render the material unsuitable for agricultural fertilizer. A composting system treating 10 dry tons sludge/day has an estimated capital cost of $376,200 and an annual operating cost of about $185,800.

D550

AIR-POLLUTING EFFECT OF ACTIVATED-SLUDGE WASTEWATER TREATMENT PLANTS
(Eleveniszapos szennyviztisztitok levegoszennyezo hatasa),

Szabo, M., Csatai, L., and Nemedi, L.

Budapesti Kozegeszsegugy, Vol. 65, No. 2, p 49-51, 1978. 5 tab, 14 ref.

The emission of airborne microorganisms was measured at two activated sludge waste water treatment plants in Budapest, Hungary. Aerosol samples were taken by the sedimentation method at several distances from the plants. The number of bacteria growing in cultures at 20 C was found to be 5,000,000/ml; at 37 C, the bacteria count was 2,000,000/ml. Occurrences of specific bacteria identified included: a Clostridium count of 3,000/40 ml, fecal coliform of 3,000,000/100 ml, fecal Streptococcus of 1,000,000/100 ml, and Pseudomonas aeruginosa of 30,000/100 ml. Tests for Salmonella were positive for 70-100% of the 100 ml samples. The maximum distance from the treatment plants at which microorganisms were found increased with increasing wind speed. At a wind velocity of 7 m/sec, E. coli was detected at distances of up to 20 m, Staphylococcus aureus and Klebsiella at up to 5 m, and Pseudomonas aeruginosa at up to 10 m from the treatment plant. The results of the study implied that the air space above biological waste water treatment plants may be a potential source of bacterial infection.

D551

THE USE OF COAGULANTS IN PRIMARY SEDIMENTATION OF SEWAGE,

Al-Momen, F. H., and Willis, H.

Wales University Institute of Science and Technology,
Cardiff,
Department of Civil Engineering and Building Technology.

Public Health Engineer, Vol. 6, No. 3, p 179-181, 1978. 3 fig, 1 tab, 10 ref.

Coagulation of primary domestic sewage with ferric chloride, aluminum sulfate, and aluminum chloride was evaluated in jar and laboratory settling column tests with respect to effluent suspended solids, BOD, and sludge filterability. Coagulant doses of 50, 100, 150, and 200 mg/liter were applied to effluent samples containing mean suspended solids concentrations of 165, 215, 256, and 362 mg/liter. An effective dose of 100-150 mg/liter ferric chloride reduced suspended solids by 80-90% and BOD by an average of 80%; this dosage also increased the capillary suction time of the sludge by a factor of 5.22 and produced a sludge with a moisture content of 99.34%. Aluminum sulfate, in an optimum dose range of 200-250 mg/liter, reduced suspended solids by 60-80% and BOD by 75%; it also increased sludge capillary suction time by a factor of 3.85, and produced a sludge with 99.25% moisture content. An effective dose of 100-150 mg/liter aluminum chloride resulted in an 85-90% decrease in suspended solids and an 80% decrease in BOD; it also increased capillary suction time by a factor of 4.19 and produced sludge with a moisture content of 99.30%. Sludge volumes more than doubled with all coagulants tested; effluent pH averaged between 7.20 and 7.50. Ferric chloride was considered the most effective coagulant of those evaluated.

D552

GRANULAR MEDIA FILTRATION OF SECONDARY EFFLUENT,

Dawda, M. M., Davidson, M. L., and Middlebrooks, E. J.

Central Weber Sewer Improvement District,
Ogden, Utah.

Journal Water Pollution Control Federation, Vol. 50, No. 9, p 2143-2156, September, 1978. 7 fig, 10 tab, 10 ref.

A dual-media tertiary filter was tested in pilot studies at the Central Weber waste water treatment plant near Ogden, Utah, as a method of polishing secondary effluent to within BOD and suspended solids standards. The SVG filter, supplied by Envirotech Corp., consisted of a 4-ft diameter tank containing a filter compartment with one ft of anthracite coal at an effective size of 1.00-1.10 mm, overlying a one ft layer of sand with a 0.45 mm effective size; the coal and sand had a uniformity coefficient of 1.7. Hydraulic loadings of 3, 4, 5, and 6 gal/min/sq ft with automatic filter backwashing were employed. One filter cycle, 16-, 18-, 20-, and 24-hr composite samples were analyzed for

BOD, suspended solids, nitrates, nitrites, ammonia, and total and orthophosphates. During summer months, chlorine had to be added to the influent to maintain a chlorine residual adequate for inhibiting the growth of Sphaerotilus which clogged the filter media. At a hydraulic loading of 3 gal/min/sq ft, filtered effluent containing less than 10 mg/liter BOD and suspended solids was produced; although this loading was considered optimum for effluent quality, a loading of 5 gal/min/sq ft was considered more economical. Smaller, more uniform media enhanced effluent quality and influenced the filter cycle duration. Chemical filtration aids, such as aluminum sulfate and cationic polymers with alum, significantly reduced the filter cycles; jar tests of coagulation aids were recommended before implementation.

D553

ULTRAFILTRATION MEETS DISCHARGE REGULATIONS AND REDUCES WASTE PUMP-OUT,

Harris, L. R., Schatzberg, P., Bhattacharyya, D., and Jackson, D. F.

David W. Taylor Naval Ship Research and Development Center,
Annapolis, Maryland.

Water and Sewage Works, Vol. 125, No. 8, p 66-71, August, 1978. 6 fig, 7 tab, 7 ref.

Ultrafiltration membrane treatment of domestic sewage from marine vessels was evaluated as a method for treatment to within the stricter discharge standards of 150 mg/liter suspended solids and 200 coliforms/100 ml. An ultrafiltration module containing seven 1-inch diameter noncellulosic tubular membranes, arranged in parallel, was used to treat several combinations of wastes including raw sewage and wastes from the galley, laundry, and shower areas. The module was operated in a semi-continuous mode at a pressure of 40 lb/sq inch and a circulation rate of 30 gal/min; a batch concentration pump-down mode was also tested with six modules in series, operated at the same circulation rates and pressure. At a feed temperature of 80 F, raw sewage exhibited the lowest flux decline slope while galley wastes displayed the highest; higher initial fluxes resulted in higher final fluxes after processing mixed wastes. The pump-down phase utilizing new membranes recovered 90% of the water after 15 hrs of processing, achieving a membrane flux of 60 gal/sq ft/day. When the feed temperature was increased to 130 F, the average flux increased, decreasing the flux decline slope; an average flux of 58 gal/sq ft/day was obtained at a feed temperature of 100 F. Membrane performance for the various waste parameters encompassed 61.5-91.0% removal of COD, 89.5-99.3% rejection of suspended solids, and more than 99% reduction of fecal coliforms. The use of a 200 mg/liter hypochlorite solution to wash the membrane restored flux reasonably well and was considered more convenient than an enzyme-detergent wash. Total operating costs for a prototype ultrafiltration system were calculated at $2.99/1000 gal.

D554

RAW SEWAGE TREATMENT AT DEER CREEK PARK,

Brar, S. S., and Miller, R. H.

Ohio Agricultural Research and Development Center,
Department of Agronomy,
Wooster.

Ohio Report, Vol. 63, No. 4, p 57-59, July-August, 1978. 2 fig, 3 tab.

An oxidation lagoon-land application pilot plant was constructed at the Deer Creek State Park in Pickaway County, Ohio, to treat raw sewage from 232 campsites. Sewage was pumped to the stabilization pond for treatment, followed by chlorination in a storage tank, and spray irrigation onto 3-acre plots of reed canarygrass, soybeans, alfalfa, and tree seedlings. Samples were collected from the raw sewage, stabilization pond effluent, storage tank waste water, surface runoff, drainage water, and test wells in and near the land application sites. The stabilization pond reduced BOD by 85% and fecal coliforms by 99.9%; carbonate formation and increased pH, resulting from carbon dioxide uptake by blue-green algae in the pond, caused the precipitation of calcium and magnesium and decreased water hardness. Total phosphorus was reduced to 0.4 mg/liter and total nitrogen to 4.6 mg/liter in stabilization pond effluent; further decreases in nutrient levels were observed in holding tank effluent and drainage water samples. Although effective treatment was obtained with the pilot system, it was noted that low usage of the camp sites during the study period resulted in atypical raw sewage characteristics.

D555

LAND DISPOSAL OF TOXIC SUBSTANCES AND WATER-RELATED PROBLEMS,

Epstein, E., and Chaney, R. L.

Energy Resources Company, Incorporated,
Cambridge, Massachusetts.

Journal Water Pollution Control Federation, Vol. 50, No. 8, p 2037-2042, August, 1978. 2 tab, 28 ref.

The physical and chemical reactions occurring in soils and plants when sludge is applied to land are reviewed. Certain heavy metals become divalent cations in acidic soils; in alkaline or neutral soils, hydroxyl ions are often formed. Soil acidity usually increases the solubility of trace elements and heavy metals, thereby increasing the uptake of these substances by plants. Organic matter may act as a chelating agent when contacted with metal ions in the soil; higher soil cation exchange capacities reduce heavy and toxic metal chelation. Reversion of toxic metals to unavailable chemical forms is controlled by soil pH, phosphate, and organic material contents; soil moisture, temperature, and aeration also control the availability of metals in the soil. Accumulations of heavy metals in plants from the application of sewage sludge, fertilizers, or pesticides can result in phytotoxic effects. Significant amounts of organic chemicals, such as polychlorinated biphenyls, and pesticides, have been found in raw sludge from Michigan and the District of Columbia. Human pathogens have been shown to survive in soils and on plants from less than one day to nearly 7 years; risks associated with these pathogens are significantly reduced when digested or composted sludges are applied to land.

D556

OZONATION IN A WASTEWATER REUSE SYSTEM: EXAMINATION OF PRODUCTS FORMED,

Elia, V. J., Clark, C. S., McGinnis, K. T., Cody, T. E., and Kinman, R. N.

Cincinnati University,
Ohio,
Department of Environmental Health, College of Medicine.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1727-1732, July, 1978. 5 fig, 1 tab, 17 ref.

The Kettering Laboratory of the University of Cincinnati in Ohio initiated experiments to examine the characteristics of water treated by a direct reuse system. The system was designed to treat raw wastes from five sources within a mobile surgical hospital, using ultrafiltration, reverse osmosis, and ozonation. A synthetic reverse osmosis permeate having a strength equivalent to 8 times that expected in a conventional hospital waste stream was contacted in a plexiglass chamber with 50 mg/liter ozone; a gas flow rate of 6.2 liters/min, feedwater flow rates of 18.9-56.7 liters/hr, and ozonation times of 18-193 min were employed. After 193 min of ozonation, total organic carbon (TOC) and COD were reduced by 28 and 31%, respectively; ozonation produced acetone, acetaldehyde, and acetic acid. Concentrations of methanol, ethanol, and isopropanol were reduced by 70, 95, and 99%, respectively, during the first 60 min of ozonation. Additional studies examined the cytotoxicity of the ozonated samples using a mammalian cell culture bioassay system. Measured TOC values were significantly higher than calculated values, suggesting that all the oxidation products had not been identified. Further studies on the effects of oxidation products in a closed-cycle direct water reuse system were recommended.

ANALYTICAL TECHNIQUES

E001
CHLORINATED WASTEWATER OUTFIT IS PORTABLE,

Water and Pollution Control, Vol. 115, No. 8, p 28, August, 1977.

The LaMotte Chemical Products Company of Chestertown, Maryland, produces a combination monitoring unit (Model MH-3) for chlorine, dissolved oxygen, and pH. For use with chlorinated waste water discharges, the unit includes a waterproof carrying case, solid state electrical components, and a combination electrode. It is a lightweight field instrument which uses a DPD-FAS titration procedure to determine free and combined chloride over a 0.1-5.0 ppm range. Dissolved oxygen in the 0-20 ppm range is determined with a microburette procedure in an Azide modification of the Winkler method. A battery-operated LaMotte pH meter is provided to measure pH from 0 to 14 within 0.1 pH units.

E002
PERFORMANCE INVESTIGATION OF THE MANNING MODEL S-4000 PORTABLE WASTEWATER SAMPLER AND THE MODEL F-3000 DIPPER FLOWMETER,

Lauch, P. R.

Instrumentation Development Branch,
Environmental Monitoring and Support Laboratory,
Cincinnati, Ohio.

1976. 62 p, 13 fig, 23 tab, 4 ref, 1 append. Technical Report EPA-600/4-76-059.

The objective of this study was to examine the operation and performance of two automatic monitors used in waste water treatment plants, the Manning model S-4000 waste water sampler and the Manning model F-3000 flowmeter. Descriptions of the two monitoring devices are presented. The sampler was tested in a laboratory environmental chamber at temperatures of 2, 20 and 35 C. Accuracy and precision, multiplexer runs, multiple bottle sampling, battery endurance, sample preservation with ice, sample representativeness, and reliability were evaluated. Tracking, analog to digital conversion, electronic drift, deadband, and overall accuracy and precision were evaluated in laboratory tests of the flowmeter. Results of laboratory studies indicated that the overall design and performance of the devices tested were above average when compared with similar equipment available for use in waste water treatment plants. Deadband or backlash in the gearing which produced an error of from 11.63% to 6.14% was considered the most serious shortcoming of the flowmeter. In field tests with treatment plant influent and effluent, the sampler reliably collected suspended solids and raw sewage while left unattended for a 24-hr period.

E003

POLLUTION STUDIES OF TRACE ELEMENTS IN SEDIMENTS FROM THE UPPER SARONIKOS GULF, GREECE,

Grimanis, A. P., Vassilaki-Grimani, M., and Griggs, G. B.

Nuclear Research Center "Demokritos",
Athens, Greece,
Department of Chemistry.

Journal of Radioanalytical Chemistry, Vol. 37, No. 2, p 761-773, 1977. 8 fig, 1 tab, 20 ref.

Instrumentation neutron activation analysis was used to analyze 84 sediment samples collected from Elefsis, Keratsini, and Piraeus Bays of the upper Saronikos Gulf in Greece. Concentrations of 17 elements were measured: As, Ce, Co, Cr, Eu, Fe, Hg, Hf, La, Lu, Rb, Sb, Sc, Sm, Yb, and Z. Isopleths for the concentrations of these elements in the upper Saronikos Gulf were extrapolated from experimental data. Lower and upper limit values of trace element concentrations in sediments are presented. Sediments collected in the vicinity of the Athens sewage outfall exhibited the highest concentrations of Cr, while all the other elements occurred at their greatest concentrations in the Piraeus Harbor region. In general, trace element concentrations were lower for Elefsis Bay than for Keratsini Bay. Industrial plants at the entrance of Piraeus Harbor, the Athens sewage outfall, and industries in the northern and eastern regions of Elefsis Bay were suggested as the major sources for the increased trace element concentrations in upper Saronikos Gulf sediments.

E004

SEWAGE SLUDGE-SOIL SYSTEMS: A STUDY OF METAL FORMS AND EFFECT OF METALS ON CARBON AND NITROGEN TRANSFORMATIONS,

Silviera, D. J.

Dissertation Abstracts International B, Vol. 38, No. 2, p 451, August, 1977.

The fate and distribution of heavy metals, including Cu, Zn, Cd, Pb, and Ni, were investigated for sewage sludge and soils amended with sewage sludge. X-ray diffraction analyses of sludge from six Indiana cities revealed that quartz, feldspar, montmorillonite, chlorite, mica, dolomite, and calcite were present in crystalline form. DTPA (diethylenetriamine-pentaacetic acid) extractibility was used in studies on the effect of soil, sludge, and environmental factors on the distribution of sludge-borne heavy metals. Metal movement through soils was reduced during frequent applications of small amounts of sludge relative to larger, more infrequent applications and was observed to be at its lowest level when sludge was applied at a rate of 22.4 metric tons/ha. The extraction of metals with DTPA was reduced under anaerobic conditions. In studies with synthetic sludge, the DTPA extractabilities of Cu, Zn, Pb, and Ni were altered by the presence of sludge organic matter while Cd was unaffected. In studies on the interaction of Cu, Zn, Cd, Pb, and Ni with C and N transformations, high heavy metal concentrations were reported to reduce nitrification by as much as 50%. The reasonable agreement of data obtained in studies with municipal and synthetic sludges has led to the suggestion that synthetic sludges be used in studies on soils-microbes-metals relationships.

E005

THE DETERMINATION OF TRACE ACRYLAMIDE IN WATER AND SLUDGE (Mizu oyobi surajji naka no biryo akuriruamido no teiryo ho),

Nakamura, H.

Suido Kyokai Zasshi, No. 514, p 37-41, July, 1977. 5 fig, 2 tab, 11 ref.

Trace acrylamide concentrations in municipal water, artificial seawater, and sewage sludge were measured with a gas chromatograph-mass spectrometer equipped with an electron capture detector. The sample containing acrylamide was brominated with the addition of a large amount of KBr and 0.1% M $KBrO_3$. The gas chromatograph column was filled with 15% EGS and the Florisil clean-up method was used in the determinations. With this method the detection range for acrylamide was 0.1-1,000 ng/liter. With the use of the standard addition method in the analysis of municipal water, artificial seawater, and sludge, acrylamide was determined within 86-93% with a relative standard deviation of less than 2%.

E006

OPTIMAL USE OF INSTRUMENTAL NEUTRON AND PHOTON ACTIVATION ANALYSES FOR MULTI-ELEMENT DETERMINATIONS IN SEWAGE SLUDGES,

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Trace Analysis Research Center,
Department of Chemistry.

Journal of Radioanalytical Chemistry, Vol. 37, No. 2, p 785-799, 1977.
4 tab, 28 ref.

A procedure involving a combination of instrumental neutron activation analysis (INAA) and photon activation analysis (IPAA) for multielement determinations in a variety of sludges and fertilizers is described. The method was devised in experiments with raw and anaerobically-digested, chemically-conditioned sludges, agricultural lime, N-P-K fertilizers, ammonium nitrate, muriate of potash, Milorganite, cattle manure, and sewage-based fertilizers. Details of the neutron and photon irradiation of the samples are presented. Experiments on the INAA method indicated that a total of 50 elements could be measured in sludge samples with 15 min and 60 hr irradiation times. Irradiation periods of 2 min and 6 hr allowed measurements of 36 elements with the IPAA method. Nuclear data for the elements detected with the methods are presented, including activation reactions, product half-lives, gamma-ray energy, and decay times. Replicate analyses of a homogenized chemical sludge sample were used to evaluate the reproducibility and accuracy of both methods. The analyses indicated that the standard deviations of most of the elements examined were 5-10% of the mean value. The choice of the analytical method should be based on the irradiation facilities available.

E007

BIODEGRADATION OF POLYMERIC BUILDERS--EXPERIMENTS WITH A C-14 LABELLED SODIUM POLY(ALPHA-HYDROXYACRYLATE),

Mulders, J., and Gilain, J.

Laboratoire Central Solvay and Cie, S. A.,
Brussels, Belgium.

Water Research, Vol. 11, No. 7, p 571-574, 1977. 5 fig, 1 tab, 5 ref.

Eutrophication of surface waters brought about by the use of phosphate-bearing detergents has prefaced this investigation of the biodegradation of polymeric polyelectrolytes, in particular sodium poly(alpha-hydroxyacrylate). Oxygen consumption and mineralization were measured in laboratory experiments. Removal of a C-14 labelled product was investigated in continuous activated sludge tests. Studies indicated that the sludge was capable of rapidly and quantitatively adsorbing the polymer and that microorganisms did not have to adapt to the product. A co-metabolism mechanism of removal is suggested by the high degree of transformation and low mineralization. Tests with acclimated sludge resulted in a higher rate of polymer assimilation and a low rate of mineralization. More than 95% of the polymer was biodegraded.

E008
EXPERIENCES WITH THE ALGAL ASSAY PROCEDURE (Erfahrungen mit der Algal Assay Procedure),

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Pflanzenschutzforschung-Biologie,
Frankfurt, West Germany.

Gas- und Wasserfach, Wasser-Abwasser, Vol. 118, No. 8, p 272-278, 1977. 6 fig, 7 tab, 6 ref.

The Algal Assay Procedure was studied with respect to its suitability for the assessment of the eutrophication of biologically purified waste water and of surface water bodies. Bottle tests with purified waste water from the last biological stage revealed that precipitation with aluminum sulfate causes a considerable reduction of the algal growth compared with that observed before precipitation. Tests with Rhine water showed that iron (II) sulfate is unsuitable for the precipitation of phosphates, if the phosphate sludge can not be removed within a short time, because the phosphate may be remobilized. Moreover, considerable growth stimulation of Anabaena flos-aquae was observed in surface water treated with iron (II) sulfate, which can be explained by the specific stimulating effect of iron. By contrast, the algal growth was significantly depressed in water treated with aluminum sulfate.

E009
COMPARISON OF FOUR-HOUR AND TWENTY-FOUR-HOUR REFRIGERATED STORAGE OF NONPOTABLE WATER FOR FECAL COLIFORM ANALYSIS,

Standridge, J. H., and Lesar, D. J.

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Madison,
Department of Natural Resources.

Applied and Environmental Microbiology, Vol. 34, No. 4, p 398-402, October, 1977. 1 tab, 14 ref.

Fecal coliform levels observed in water samples stored for 4 hr at 4 C were compared with those observed in the samples after 24 hr of storage. Samples for analysis were obtained from secondary sewage treatment plants receiving only domestic wastes, from plants receiving a combination of municipal and industrial wastes, and from rivers and streams receiving a mixture of municipal and agricultural wastes. The membrane filter technique was used in the 30 replicate analyses of each sample at 4- and 24- hr periods. The 5-day biochemical oxygen demand in mg/liter was measured for each sample. A statistical comparison of the analyses conducted for 4- and 24-hr storage periods indicated that fecal coliform levels obtained were equivalent within the 95% confidence interval for all but three sampling sites. Two of three sites were reported as grossly overloaded sewage plants producing a poor final effluent, and the third was one in which vacuum filtration was used after final clarification. The test results suggested that storage of samples for 24-hr could result in reliable analyses with economic and qualitative advantages over storage for 4 hr.

E010

ANALYSIS FOR TOXIC SUBSTANCES PRESENT IN WASTE WATER FOR BIOLOGICAL PURIFICATION PURPOSES (Pruefung von Abwasserinhaltsstoffen auf Giftwirkung fuer die biologische Klaerstufe),

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Eidg. Materialpruefungs-und Versuchsanstalt (EMPA),
St. Gallen, Switzerland.

Gas-Wasser-Abwasser, Vol. 57, No. 7, p 520-523, 1977. 4 fig, 1 tab, 7 ref.

A simple method for testing inorganic and organic substances for their toxicity with respect to the activated sludge of biological waste water treatment plants is described. The substance to be tested is added in various concentrations ranging from 5 to 1,000 mg/liter to activated sludge taken from biological waste water treatment plants, and the resulting reduction in the oxygen consumption is determined by a known (barometric, coulometric, etc.) method. Substances which reduce the oxygen consumption to 50% in concentrations over 500 mg/liter are considered as non-toxic or of low toxicity, while substances with LC50 under 100 mg/liter are highly toxic to the activated sludge.

E011

I. DYNAMICS OF MERCURY IN LAKE SEDIMENTS, II. STUDIES ON ORGANIC PHOSPHORUS IN SOILS IRRIGATED WITH MUNICIPAL WASTEWATERS,

Floyd, M.

Dissertation Abstracts International B, Vol. 38, No. 2, p 446-447, August, 1977.

The synthesis and degradation of alkylmercury compounds in sediments, the effects of municipal waste water irrigation on the levels of phosphotase in soils, and the stability of organic phosphorus compounds in humic polymers were examined in laboratory experiments. Studies indicated that mercury was not significantly transformed in sediments, and that microbial activity was necessary for the degradation of alkylmercury compounds in natural sediments. Studies with waste water irrigated soils revealed that phosphotase activity was dependent on the crop grown and based on the following relationship: reed canary grass > hardwood forest on clay loam > old field > hardwood forest on sandy loam > corn.

E012
A SEMICONTINUOUS EXPERIMENTAL TECHNIQUE FOR THE STUDY OF THE INFLUENCE OF MIXING CONDITIONS ON THE HOMOGENEITY OF SEWAGE SLUDGE,

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Basico e de Defesa do Meio Ambiente (CETESB),
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Biotechnology and Bioengineering, Vol. 19, No. 7, p 1087-1090, July, 1977.
2 fig, 2 ref.

A semicontinuous experimental technique for defining correlations between mixing and sludge homogeneity with anaerobic digestion is presented. Small volumes of sludge are periodically removed from the digester and the same volume of water is added. A series of equations relating the amount of sludge removed, the effective dilution, and the sludge concentration are presented. The system can be considered homogeneous if the final sludge concentration follows a prescribed function. Possible experimental errors are indicated when the volume of sludge periodically removed from the digester is large with respect to the total volume of sludge in the digester. However, the dilution factor and the time interval between sample removal must be sufficiently large for proper equilibration of the system. An example of the semicontinuous technique in an experiment with sewage sludge from a primary settling tank at the Pinheiros sewage treatment plant in Sao Paulo, Brazil, is presented.

E013
SPECTROPHOTOMETRIC DETERMINATION OF RESIDUAL HYDROGEN PEROXIDE,

Massachelein, W., Denis, M., and Ledent, R.

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Brussels, Belgium.

Water and Sewage Works, Vol. 124, No. 8, p 69-72, August, 1977. 2 fig, 34 ref.

Hydrogen peroxide (H2O2) a strong oxidizing agent, decomposes by reactions in water and leaves residual oxygen. Applications of hydrogen peroxide in waste water treatment include oxidation of sulfhydric acid and mercaptans, indirect oxidation of phenols, aeration, disinfection in reservoirs, and elimination of taste or odor caused by chlorine or chloramines in drinking water. Various analytical methods for determining residual H2O2 concentrations are described. Existing methods include colorimetric determination with titanium(IV) salt (chloride or sulfate), with phenolphthalein in the presence of Cu(+2), or with oxygen-sensitive electrodes which have been adapted for use with H2O2 by incorporating a suitable catalyst (MnO2, Co2O3, or Ru2O3) in the electrode membranes. The cobalt-bicarbonate-H2O2 method for determination of H2O2 is described. Standard solutions containing H2O2 are titrated with ammonium molybdate and neutral potassium iodide. Sodium hexametaphosphate, Co(+2), and a saturated sodium bicarbonate solution are added to samples, producing an intense bicarbonate green color which is probably caused by the presence of a CO(+3) carbonate complex. Absorption is measured with a spectrophotometer at 260 nm. The reported detection limit is about 0.01 mg/liter H2O2 with possible interference caused by turbidity or suspended particles. A graph for optical density (absorption) as a function of H2O2 concentration is provided.

E014

EVALUATION OF A NITRATE-SPECIFIC ION ELECTRODE,

Yu, K. Y., and Berthouex, P. M.

Southern California University,
Los Angeles,
Environmental Engineering Programs.

Journal Water Pollution Control Federation, Vol. 49, No. 8, p 1869-1901, August, 1977. 1 fig, 9 tab, 7 ref.

The Simple Electrode and the Standard-Addition Electrode methods are used to evaluate nitrate determinations with a nitrate-specific ion electrode and the Brucine method using effluent samples from biological treatment units. The nitrate electrode measures nitrate activity in terms of potential across a layer of water-immiscible ion exchanger held in place by an inert porous membrane. Electrode behavior follows a Nernst relation within the working range. Ionic interference is usually counteracted by the addition of a buffer to maintain constant ionic strength. The Standard-Addition or Known-Increment method involves the addition of a known amount of nitrate to a solution containing an unknown amount. The quantity of nitrate present in the initial solution is determined by measuring the change in potential produced by the additional nitrate. Grab samples of waste water effluent with nitrate concentrations ranging from 2-20 mg/liter were collected from nitrification pilot plants. Higher readings obtained with the Simple Electrode method than with Standard-Addition were attributed to greater influence of high hardness and alkalinity in the waste water on simple electrode determinations. Standard errors for nitrate determinations with the Brucine method were higher than for either electrode method, and procedures were more time-consuming, requiring reagent preparation. The specific-nitrate ion electrode is recommended as a relatively inexpensive, fast, portable means of nitrate determination in waste water for concentrations as low as 1 mg/liter nitrate-N.

E015

CHEMICAL REGENERATION OF GRANULAR ACTIVATED CARBON,

Paccari, M., Paolini, A. E., and Variali, G.

Rome University,
Italy,
Physical Chemistry Institute.

Effluent and Water Treatment Journal, Vol. 17, No. 6, p 290-294, June, 1977.
4 fig, 4 tab, 20 ref.

Regeneration of the adsorption capacities of granular activated carbon which had been exhausted by peptone was investigated. Peptone solutions with various COD levels were percolated through beds of activated carbon. Tests were carried out at 20 C and 30 C. Langmuir and Freundlich isotherms relating the COD of the solution and the weight of adsorbate and adsorbent with equilibrium conditions were calculated. Batch and continuous testing procedures were outlined. Thermodynamic analysis and adsorption isotherms indicated that the relationship between adsorbate and adsorbent followed the van't Hoff-Arrhenius equation with a change in enthalpy of -6.36 kcal/mole. An examination of adsorption kinetics revealed that the rate-limiting step was intraparticle diffusion. Regenerating capacities were measured for various oxidizing and non-oxidizing agents. In batch tests, oxidants did not have appreciable chemical regenerating abilities, while non-oxidizing agents exhibited regenerative efficiencies of not more than 50%. The extractive capacities of non-oxidizing agents were improved by alkaline pretreatment at 80 C, with alkaline pretreatment itself having an extractive efficiency of 50%. Continuous studies with several regenerative cycles showed a decrease in regenerative efficiency after the first two cycles.

E016

BIOLOGICAL AND ECOLOGICAL STUDIES ON THE INTERACTION OF BDELLOVIBRIO AND ENTEROBACTERIACAE,

Westergaard, J. M.

Dissertation Abstracts International B, Vol. 38, No. 2, p 525, August, 1977.

The occurrence of Bdellovibrio and its possible hosts (Enterobacteriaceae, Pseudomonadaceae, Vibrionaceae, Neisseriaceae, Chromobacterium, Streptococcus, Rhodotorula, Escherichia coli, Klebsiella pneumoniae, and Salmonella pullorum) was investigated with water samples collected from wells, ponds, streams, waste water oxidation lagoon systems, and municipal waste water treatment plants. Although Bdellovibrio was most easily isolated from municipal waste water, studies indicated that Bdellovibrio was not incorporated into the intestinal microfloral population of animals and was not considered a threat to poikilothermal and homeothermal animals. The simultaneous 3-log reduction in Bdellovibrio and the host E. coli when a waste water innoculated mixture was incubated for 72 hr suggested that biological purification of waste water by Bdellobivrio was minor.

E017

OBSERVATIONS ON PRE-ENRICHMENT FOR ISOLATING SALMONELLAS FROM SEWAGE POLLUTED NATURAL WATER USING MULLER-KAUFFMANN TETRATHIONATE BROTH PREPARED WITH FRESH AND DESSICATED OX BILE,

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Cardiff,
Public Health Laboratory Service.

Journal of Applied Bacteriology, Vol. 43, No. 1, p 145-148, August, 1977. 2 tab, 13 ref.

Dessicated ox bile was evaluated as a substitute for fresh bile in the preparation of Muller-Kauffmann Tetrathionate Broth for the isolation of salmonellas from sewage-polluted waters. Salmonellas in water samples collected from the Taff River in Wales were isolated in media which had been prepared with fresh bile, dessicated bile, or a combination of the two. The media had also been directly enriched or had undergone pre-enrichment followed by enrichment. Studies on enriched samples indicated that fresh bile was more efficient for isolating salmonella than dessicated bile. With pre-enrichment, both forms were equally satisfactory.

E018

COMPUTERS AND INSTRUMENTATION--PARTNERS IN TREATMENT PLANT OPERATION,

Zucchetti, R.

Water and Pollution Control, Vol. 115, No. 8, p 9-11, August, 1977. 1 fig.

The use of computers and instrumentation systems is considered for providing automatic control and operation monitoring in municipal water and waste water treatment. Topics discussed include the importance of primary sensing elements, data logging, digital control centers, microprocessors, and troubleshooting. A typical wiring diagram for a microprocessor which can be used to monitor filters, headloss, turbidity, and flow rate is presented. Criteria which may be useful in the evaluation of a computerized monitoring system for plant operation are presented.

E019

A MORE PRECISE METHOD OF DETERMINATION OF SPECIFIC RESISTANCE TO FILTRATION,

Wuhrmann, K. A.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 377-378, 1977. 2 fig, 1 tab, 2 ref.

The method of determination of specific resistance to filtration of substances such as sewage sludge was refined with the design of an automatic device for filtrate sampling. The resistance to filtration is normally expressed as a function of the flow gradient of the filtrate calculated on the basis of the filtrate volume as a function of time, the filtering pressure, the active filtering area, the dry residue, and the dynamic viscosity of the liquid. The automatic resistance measuring device registers the time to obtain two predetermined volumes of filtrate from a standardized filtering apparatus. A comparison of results obtained from eight series of five conventional and five automatic measurements is presented.

E020

LEVEL INSTRUMENTATION IN EFFLUENT TREATMENT PLANTS,

Water and Pollution Control, Vol. 115, No. 9, p 29-34, September, 1977. 6 fig.

Analytical instrumentation and flow monitoring devices available for use in waste water treatment plants are discussed. General detection methods employed in flow measurement and control include sonic, ultrasonic, capacitance probe, vibrating probe, windlass, nuclear, microwave, and radar. Sonic and ultrasonic systems are used to provide non-contact level measurements based on reflected pulses whose echos are received by an emitting transducer located above the water surface. Sonic and ultrasonic systems such as the E + H Aquatot system can be used at various points in a sewage plant, including the in-flow points, between primary and secondary treatment facilities, and at outflow points. They can also be used for automatic bar screen control, screw pump control, and slide valve control in an activated sludge tank. Large-scale application of sonic controllers to monitor groundwater levels and control pump start-up in Richmond, British Columbia, Canada, is described. The E + H Aquatot system has also been used for open channel measurement by the city of Thompson in Manitoba, Canada. The change in electrical capacitance between a probe and the wall of a tank is used to operate capacitance systems for operation and automatic sequencing of a pumping system. The E + H tuning fork, or Vibratrol instrument, contains a piezoelectric element which is used for underwater detection. Additional applications of monitoring instruments produced by Endress and Hauser of West Germany are discussed for mechanical windlass instruments, nuclear and microwave measurement, gamma radiation, microwave control, and other instrument types.

E021

LAB MODERNIZATION CREATES NEW PROBLEMS FOR PLANT OPERATORS,

Clark, D. W.

Water and Sewage Works, Vol. 124, No. 10, p 82-83, October, 1977.

The addition of a water quality laboratory to the 4.5-mgd waste water treatment plant at Las Cruces, New Mexico, has included the installation of automatic samplers, a spectrophotometer, a camera-equipped high power microscope, Kjeldahl nitrogen apparatus, grease extraction apparatus, a continuous-reading electrolytic BOD system, and a water purification system. The need for trained personnel in the field of water quality monitoring is discussed. Major divisions of water quality analysis for sewage treatment plants include: the identification of finished water contaminants, such as heavy metals and pesticides, and their effects on the environment; evaluations of new treatment processes; development of new testing procedures; surveillance of pollutants unaffected by present treatment processes; protection of the treatment process through upstream monitoring; and the determination of charges for industrial waste effluents.

E022

MASS TRANSFER AND MIXING IN THE KENICS AERATION SYSTEM,

Chen, S. J., and Gilbert, R. G.

Kenics Corporation,
North Andover, Massachusetts.

AIChE Symposium Series, Vol. 73, No. 167, p 23-32, 1977. 11 fig, 3 tab, 11 ref.

The full-scale test facility used in the evaluation of the Kenics Aeration System includes a 38.5-ft diam, 32-ft deep cylindrical steel tank, an aeration system with 46 Kenics aerators, a 2000-scfm rotary positive, a distribution piping system, air flow meters, a chemical feed system for deoxygenation, and dissolved oxygen analyzers. Oxygen transfer efficiency is measured with the clean water sodium sulfite method. Four methods of analysis used to evaluate oxygen transfer efficiency are described: direct analysis, exponential curve fitting, the rapid estimate (time constant) technique, and log deficit (semilog). An equation for the standard oxygenation rate (SOR) is presented. The analytical techniques were tested in three aeration tests under conditions representing a typical completely-mixed activated sludge aeration system. Methods for determining direct pumping capacity and mixing are described. Field tests to determine the solids suspension characteristics of Kenics Aeration Systems are described. An expression for oxygen transfer as a function of SOR and the wire or line electric horsepower (LHP) is presented.

E023

MASS TRANSFER IN LARGE SECONDARY TREATMENT AERATORS,

Uhl, V. W., Winter, R. L., and Heimark, E. L.

AIChE Symposium Series, Vol. 73, No. 167, p 33-41, 1977. 6 fig, 5 tab, 17 ref.

A 40-ft square basin filled to a depth of 20 ft with tap water was used in studies to provide values for oxygen uptake rate and mass transfer coefficient for large-scale aeration systems such as those used in secondary waste water treatment. Procedures for power consumption tests and oxygen transfer measurements are described. Tests with the aeration basin were run at mixer drive output speeds of 30 and 56 RPM; with impellers of 66", 72", 75", and 122" diameters; and with blower gas rates from 280 to 1570 scfm. Regression analyses of semi-log plots of the oxygen saturation deficit data acquired during 18 tests were used to calculate mass transfer coefficients. Five correlation schemes incorporating various configurations of gas turbine input, liquid volume, impeller speed, superficial gas velocity, impeller shaft torque, and impeller discharge rate were evaluated in terms of yielding a "best fit" for the experimental data. An optimization procedure to maximize the amount of oxygen transferred in lb/hr per total horsepower is presented.

E024

INVESTIGATION OF MUTAGENIC EFFECTS OF PRODUCTS OF OZONATION REACTIONS IN WATER,

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Washington, District of Columbia.

Annals of the New York Academy of Sciences, Vol. 298, p 124-140, 1977. 5 ref.

Potential hazards posed by chlorinated organic chemicals in waste water and drinking water after disinfection by chlorination have led to an evaluation of potential biological activity of products of ozonation, an alternate means of disinfection. Rapid in vitro microbiologic bioassays of 28 selected organic compounds subjected to high levels of ozone, as well as similar analyses on municipal secondary treated waste water which had been disinfected with various agents, were used to evaluate mutagenic activity in Saccharomyces cerevisiae D3, Salmonella, and a rat liver homogenate. Process conditions were more severe than those in conventional ozone treatment. Only seven of the 28 organic compounds tested showed any mutagenic activity, and in those cases the activity was not dose-related and usually resulted from prolonged ozone exposure.

E025

APPLICATION OF THE RAPID LYSINE DECARBOXYLASE TEST FOR EARLY ISOLATION AND DETECTION OF SALMONELLAE IN SEWAGE AND OTHER WASTEWATERS,

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Applied and Environmental Microbiology, Vol. 34, No. 4, p 453-455, October, 1977. 1 tab, 18 ref.

The lysine decarboxylase (LD) test has been among several test schemes advocated for identification of Enterobacteriaceae and has been used in conjunction with hydrogen sulfide production to verify the presence of Salmonellae. The application of the rapid lysine decarboxylase test for isolation and detection of Salmonellae was evaluated in experiments with 39 waste water samples, including raw sewage, settled sewage, treated effluent from facilities at the National Environmental Engineering Research Institute in India, and raw and filtered slaughterhouse wastes. The test involved inoculation of samples into Kauffman tetrathionate broth, incubation at 41.5 C for 24 or 48 hr, streaking of the enriched culture on BGA plates, and incubation of the BGA plates for 18 hr at 37 C. Colonies exhibiting a pink or magenta hue were then inoculated into tubes which contained lysine broth, and sterile 0.5% plain agar was added. The tubes were incubated in a dry-air, water-jacketed unit at 37 C and read at 1-, 2-, 3-, and 4-hr intervals. The development of a green or blue color was considered as a positive indication of LD activity. Tests with the LD method which revealed Salmonellae presence in 129 of 205 colonies were verified with the modified Kohn method and with slide agglutination tests of 6-hr growth obtained on nutrient agar slopes. The LD test was capable of identifying and isolating Salmonellae within 2-3 days, as compared to 5-7 days with conventional methods.

E026

COMPUTER CONTROL OF LARGE-SCALE WASTEWATER TREATMENT PLANT,

Kato, S., Nagasaki, R., Ohto, T., Nogita, S., and Tanuma, M.

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Tokyo, Japan.

Hitachi Review, Vol. 26, No. 7, p 229-234, 1977. 10 fig, 6 ref.

Results of experiments with analog and digital DO/air control systems conducted at the Mikawashima activated sludge treatment plant in Tokyo, Japan, are presented. The analog control system includes a controller with proportional and integral functions, a valve-opening control element, and a power-actuated butterfly valve. Studies on DO control with the analog system for four parallel aeration tanks resulted in DO values within 0.3 mg/liter of the desired value of 2 mg/liter. Lower control precision at 4 mg/liter DO was attributed to nonlinear characteristics of the butterfly valve. Functions of the MINIDIC direct digital control system used in the study include filtering of input data, feed-forward control based on a flow meter, feedback compensation of valve opening angle, feedback control based on a DO meter, and compensation of nonlinear characteristics between valve opening angle and flow rate. Experiments with the digital controller were conducted with MLSS levels of 1,000 or 2,000 mg/liter and DO levels of 2, 4, and 6 mg/liter. The digital controller was effective in reducing valve actuating frequency to one-fifth of the frequency when the analog controller was used. The AQUAMAP-80F system, a computer control system for a large-scale waste water treatment plant, has been devised by Hitachi Ltd. of Japan for controlling flow rate, electrical devices, and water quality and for providing a data bank of treatment plant operations. Three mathematical models are presented for use in feed-forward control and waste water treatment process simulation, including models for water quality, transparency, and dissolved organic matter concentrations.

E027

OZONE EFFECT ON NITROGENOUS MATTER IN EFFLUENTS,

Narkis, N., Wachs, A. M., and Schneider, M.

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Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 877-891, October, 1977. 6 fig, 7 tab, 16 ref.

Experiments with lime-treated effluent from a biological municipal waste water treatment plant and solutions of nitrogenous compounds were used to examine the effects of ozone on nitrogenous matter in effluents. The pH of the solutions was adjusted to values from 2.8 to 12.2 and ozonation was carried out at a concentration of 20 mg O_3/liter O_2, a gas mixture flow rate of 0.4 liter/min, and contact periods of 15-120 min. In studies with lime-treated secondary effluents, ozonation produced nitrates which never increased above a concentration of 12 mg/liter, and total oxidation of organic nitrogen and ammonia was not achieved. At pH values below 6 nitrates were not produced, while nitrification increased significantly above pH 9 to reach a plateau level of 8.0 mg/liter beyond pH 10. The buffering capacity of lime treatment lowered the pH of the effluent during ozonation and inhibited nitrification. Increasing the length of the ozonation period decreased TKN, ammonia-N, and organic-N with a concurrent increase in nitrates in the treated effluent. Studies on the effects of the presence of ammonia on COD removal indicated that the oxidation of ammonia during ozonation did not affect the degree of removal nor the oxidation of organic compounds responsible for COD in the lime-treated effluent. The effects of ozonation on specific nitrogenous compounds in aqueous solutions were examined in experiments with $NaNO_2$, NH_4Cl, amino acid leucine solutions, borate and phosphate buffers, and bovine serum albumin.

E028

SHORT-TERM WATER COLUMN PERTURBATIONS CAUSED BY WASTEWATER SLUDGE DUMPING IN THE NEW YORK BIGHT APEX,

Duedall, I. W., O'Conners, H. B., Oakley, S. A., and Stanford, H. M.

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Department of Oceanography.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2074-2080, October, 1977. 6 fig, 1 tab, 13 ref.

The behavior of waste water sludge in the marine environment was evaluated during a two-day moratorium on waste sludge dumping in the New York Bight apex. Background information on temperature, salinity, pH, in vivo chlorophyll fluorescence, turbidity, dissolved oxygen, suspended solids, chlorophyll a, ammonium, nitrite, nitrate, phosphate, and silicic acid was obtained at a marker buoy site before and after dumping of digested waste water sludge. A subsurface current cross drogue was used to estimate the net direction and drift of the near-surface water layer immediately after dumping. The 2890 cu m of waste sludge from the Newton Creek waste water treatment plant produced a plume about 200-250 m in diameter within 10-15 min after discharge. The plume visibly blackened the surface water for about 30 min after dumping and moved in a southeast direction away from the discharge point. Sludge dumping did not significantly affect temperature, salinity, pH, and dissolved oxygen and chlorophyll a concentrations in the water column. The dumping did, however, produce dramatic perturbations in the nutrient and suspended solids concentrations in the water column. Bottom dilutions of phosphates and suspended solids were measured at 1:185 and 1:2000 parts, respectively, in seawater 40 min after dumping and 1:1300 and 1:6500 at 157 min after dumping. The ammonium to seawater ratio was 1:12 at 157 min after dumping. The presence of a thermocline inhibited upward mixing of the sludge-seawater mixture.

E029
SAMPLES OF RHINE WATER REVEAL ORGANIC CARBON CONTENT,

Sontheimer, H.

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West Germany,
Engler-Bunte Institute, Department of Water Chemistry.

Water and Wastes Engineering, Vol. 14, No. 10, p 24, 26-27, October, 1977. 2 fig.

Dissolved organic carbon, COD, ultraviolet extinction, oxygen content, temperature, and flow rate were measured in water samples collected at seven stations along the Rhine River in West Germany. Because current, temperature, and the nature and quantity of pollutants contribute to a wide variation in organic substances within the Rhine, the geometric means of several analyses was used in comparisons of analytical data with time of collection and location. The analyses indicated that a major increase in dissolved organic carbon, COD, and ultraviolet extinction occurred at Mainz, where effluents from the Mannheim-Ludwigshafen area were discharged. Concentrations below this point were relatively constant despite further considerable discharges of effluent, verifying the river's capacity for self-purification. The study concluded that the total dissolved organic carbon pollutant load increased with flow rate. A decrease in the load of biologically degradable substances with a decrease in flow rate was attributed to more time available for self-purification under conditions of low flow rate. Since deviations in COD values were greater than in dissolved organic carbons from curve fitting of 1970-1974 values, the use of dissolved organic carbon rather than COD was suggested for determining river quality. An equation to estimate pollutant loading with respect to flow rate was presented. The effects of the large BASF water treatment plant in Ludwigshafen on the quality of the Rhine were discussed.

E030
SONICATION OF ACTIVATED SLUDGE FLOCS AND THE RECOVERY OF THEIR BACTERIA ON SOLID MEDIA,

Banks, C. J., and Walker, I.

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Heslington, England,
Department of Biology.

Journal of General Microbiology, Vol. 98, No. 2, p 363-368, February, 1977. 5 fig, 1 tab, 12 ref.

Since the enumeration of activated sludge bacteria is dependent on the ability to release them undamaged from sludge, the optimal conditions for bacteria recovery were investigated with ultrasound And sludges grown under different nutrient and hydraulic conditions. Samples of mixed liquor from the aeration tanks of an activated sludge plant were diluted and sonicated for periods ranging from 20 to 240 sec at five different intensities. Floc breakage was assessed according to the absorbance of the supernatant at 400 and 610 nm. Changes in temperature were used as a measure of energy input, and plating techniques were used to quantify the release of viable organisms during floc disruption. Experiments indicated that floc breakage depended on the intensity rather than the duration of sonic input, although bacteria release was controlled by intensity and duration. A sonication period of 80-100 sec at an intensity of 26 J/sec yielded the most viable bacteria. Measurements of the heating effect of sonication indicated that the creation of temperatures lethal to bacteria was unlikely, since sonication over 140 sec at maximum power output only increased the temperature from 0 to 13 C. Bacteria determinations conducted in diluted sonicated mixed liquor from six municipal treatment works with CGY, MP, and TGEVA agars indicated that recovery was dependent on the particular sludge and its suspended solids and viable bacteria content.

E031

WASTE WATER SURVEY OF A PARTIALLY SEWERED CITY,

Mahmood, T. A., Kanbar, S. A., and Ahmed, S.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 103-107, June, 1977. 4 fig, 4 tab, 10 ref.

A field study was conducted to examine quantitative and qualitative aspects of waste water in Mosul, Iraq, a city with an estimated population of 350,000. Much of the industrial and domestic waste water generated in the city is discharged to the Tigris River without treatment. During June, July, and August, 1972, bi-hourly flow measurements were taken at the city's 10 major outfalls. Additional parameters measured during the survey included BOD and a deoxygenation constant. Minimum, maximum, and average flow rates were computed for each station. Individual hydrographs were calculated to illustrate daily variations in waste water flow. The hydrographs indicated that one peak in waste water flow occurred in areas that were predominantly residential, while multiple peaks occurred in areas which had mixed commercial and residential uses. The per capita waste water flow for Mosul averaged 280 liters/day. Waste water analyses were conducted with bi-hourly samples which were mixed to produce a flow-proportioned, 25-hr composite sample. Characteristics examined included total, suspended, and settleable solids; BOD; organic nitrogen; organic, ammonia, and nitrate nitrogen; chloride; pH; fat; alkalinity; total bacteria; and coliform bacteria. Analyses indicated that the waste water was primarily domestic in origin.

E032

GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC IDENTIFICATION OF PHENOLS AND AROMATIC ACIDS IN RIVER WATERS,

Matsumoto, G., Ishiwatari, R., and Hanya, T.

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Japan,
Department of Chemistry.

Water Research, Vol. 11, No. 8, p 693-698, 1977. 7 fig, 2 tab, 21 ref.

The presence of phenols and aromatic acids in the Tama and Sumida Rivers in Tokyo, Japan, was investigated in laboratory experiments with gas chromatography-mass spectrometry. Water samples were subjected to ethyl acetate extraction and silica gel column chromatography. Separation procedures used for the analysis of phenols and aromatic acids are described. Analyses indicated that the ratio of ethyl acetate extracts to total organic matter was about 10% for each river water sample. Phenols and aromatic acids identified in the Tama River included: pentachlorophenol, phthalic acid, trimesic acid, p-hydroxybenzoic acid, vanillic acid, syringic acid, p-coumaric acid, ferulic acid, bisphenol A, o-hydroxybenzoic acid, and m-hydroxybenzoic acid. All of these compounds except p-courmaric acid, ferulic acid, and bisphenol A were detected in the Sumida River. Possible sources are hypothesized for each of the compounds. It is suggested that pentachlorophenol, bisphenol A, and phthalic acid are probably industrial in origin, while the phenolcarboxylic acids probably originated from lignin-like matter and urine.

E033

VIRUS DETECTION SYSTEM,

NASA Tech Briefs, Vol. 2, No. 2, p 239-240, Summer, 1977. 2 fig.

A nonpathogenic marker virus, bacteriophage F2, is used as a tracer in a water reclamation system to determine if other, possibly more toxic, viruses have survived the treatment process. The virus is first concentrated by adsorption onto cellulose acetate filters in the presence of trivalent cations (AlC13) at low pH. A passive immune agglutination test, in which an antibody or an antigen is bound to latex beads, is used to detect the marker virus. The waste water detection system includes a reagent pump and metering system, reagent storage containers, a filter concentrator, an incubation/detector system, and an electronic readout and control system. Peristaltic pumping is used to control the flow sequence of the reagents and samples, and a transmitted-light photometer is used to measure the degree of agglutination.

E034
ULTRASONIC SLUDGE DIP STICK,

Water Services, Vol. 81, No. 978, p 526-527, August, 1977.

The USP 10 ultrasonic sludge level meter has been produced by Krohne Measurement and Control Ltd. of Moulton Park, England. A probe which contains an ultrasonic transmitter/receiver is suspended from a fixed cabinet in the sludge settling tank. The strength of pulses returned by a reflector connected to the probe is proportional to the position of the sludge interface, with pulses being weaker when absorption by suspended solids is at its maximum. The probe measuring depth range is 1-10 m and the probe can be raised and lowered automatically or manually. The probe can be positioned to correspond to suspended solids contents of 0.3-10%, and indication of the probe depth is available. The probe can be moved at a speed of 0.66 m/min. With the use of two limit switches, the input of raw material and the extraction of clear water and sludge can be controlled.

E035
SEROLOGICAL TYPING AND CHLORINATION RESISTANCE OF WASTEWATER CYANOPHAGES,

Stanley, J. L., and Cannon, R. E.

Virginia Medical College,
Richmond,
School of Dentistry.

Journal Water Pollution Control Federation, Vol. 49, No. 9, p 1993-1999, September, 1977. 2 fig, 2 tab, 15 ref.

The chlorine resistance of waste water-isolated cyanophages and their ecologic distribution according to serological typing were evaluated with regard to the use of LPP-cyanophages as possible indicators of animal viruses and coliforms in waste water. Samples of waste water were collected on a biweekly basis from the inflow, following primary settling tanks, following trickling filtration, and after chlorination at the Buffalo Creek sewage treatment plant in Greensboro, North Carolina. Concentrations of LPP-cyanophages and Plectonema boryanum, a species of filamentous blue-green algae which is attacked by LPP-cyanophages, were measured. Cyanophages were observed in waste water on a year-round basis, with a decline during the winter months attributed to a decline in the cyanophage host algae. Studies on inactivation of stock cyanophages and cyanophages isolated from waste water indicated that the latter were much more resistant to chlorination. Since cyanophages also appear to be more resistant to chlorination than enteric viruses, cyanophage monitoring is suggested as an inexpensive, reliable, simple method of testing for viral and bacterial contamination.

E036

LEARN MORE ABOUT VARIABLE SPEED PUMPING/2,

Gottliebson, M.

Water and Wastes Engineering, Vol. 14, No. 10, p 58-59, 62-64, 68, 90, October, 1977. 27 fig.

Various considerations in the selection of pumping systems are discussed with respect to insuring sufficient pumping capacity to discharge the peak influent rate when any single pump in a series is out of service. Various configurations of one-, two-, and three-pump variable-speed pumping systems are discussed. The use of efficiency curves for optimum arrangement of the "lag" and "lead" pumps in a variable speed system is described. Basic operating modes include the load sharing mode, in which lead and lag pumps operate at the same speed and discharge rates, and the staggered mode, in which the lead pump operates at maximum speed while the lag pump discharges the portion of influent which exceeds the capacity of the lead pump. The use of a variable-speed controller in staggered pump operation is described. Power requirements and efficiency ratings for load sharing are compared with values for staggering. A series of guidelines for the operation of a variable-speed sewage pumping system are described. Configurations involving the combination of variable-speed pumps with constant-speed pumps are evaluated. Limits placed on maximum speed are controlled by the speed at which pump cavitation is produced. Methods of pump failure detection and pumping system control are described.

E037

HOW RELIABLE IS INSTRUMENTATION IN WASTEWATER APPLICATIONS?,

Molvar, A. E., Babcock, R. H., Roesler, J. F., and Wise, R. H.

Raytheon Company,
Portsmouth, Rhode Island.

Instruments and Control Systems, Vol. 150, No. 10, p 29-33, October, 1977. 1 tab.

Measurement principles, potential applications, operating characteristics, and user's experiences are discussed for analytical sensors, transducers, and monitoring devices observed during a survey of 50 waste water treatment plants. Data presented for instrument operating experiences include variable, type of instrument, applications, typical cost, mean time between failures, typical life expectancy, and maintenance requirements in terms of frequency/hr, maintenance-hrs/yr, and skill level. Types of instruments discussed include level-measuring devices, flow meters, wet chemical analyzers, sludge density meters, and pH electrodes. Monitors for TOC, COD, TOD, DO, residual chlorine, chlorine gas, flammable gas, and turbidity are also evaluated.

E038

STUDY OF A SEPTIC TANK SYSTEM ON A LAKE SHORE: TEMPERATURE AND EFFLUENT FLOW PATTERNS,

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Taupo, New Zealand.

New Zealand Journal of Science, Vol. 20, No. 1, p 55-61, March, 1977. 7 fig, 10 ref.

Septic tank effluent seepage was mapped over a shallow groundwater table near Lake Taupo in New Zealand to determine whether septic effluent was entering the lake. Because conventional tracer methods were prohibited by the area's low groundwater velocities, the extent and direction of movement was traced by measuring temperature changes produced at the groundwater surface by the effluent. A network of 10-mm dia boreholes laid out on a grid pattern at 1-m centers was used to monitor effluent movement. A finite difference method was used to determine the path of the effluent from the septic tank soakhole to the test borehole. Elevated temperatures were observed in the surface water at nearly all of the borehole sites, with a sharp thermal gradient below about 0.2 m and background groundwater temperature at about 1 m. A thermal plume which emanated from the soakhole was observed, with effluent water travelling considerable distances before entering the groundwater. The thermal buoyancy of the septic tank effluent and the thermal gradient between it and the background groundwater confined effluents to the upper 0.2 m of the water table at distances greater than 8 m from the soakhole. The probability of septic effluents reaching Lake Taupo in this situation was considered significant. This groundwater temperature mapping technique is recommended for areas where low groundwater velocities or anisotropic soil properties limit the application of traditional tracer techniques.

E039

QUANTITATIVE MAPPING OF SUSPENDED SOLIDS IN WASTEWATER SLUDGE PLUMES IN THE NEW YORK BIGHT APEX,

Johnson, R. W., Duedall, I. W., Glasgow, R. M., Proni, J. R., and Nelsen, T. A.

National Aeronautics and Space Admistration,
Hampton, Virginia.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2063-2073, October, 1977. 11 fig, 1 tab, 13 ref.

Since large quantities of waste are dumped into the apex of the New York Bight and little is known about the dispersion of these wastes in coastal waters, studies were conducted to quantitatively map waste water sludge plumes on the basis of water quality properties and remotely sensed data. The testing program took place after a 2-day moratorium on sludge dumping in the Bight apex. Aircraft remote sensing and two surface vessels were used to map three waste water sludge plumes on September 22, 1975, with comparisons of suspended solids and chlorophyll-a concentrations obtained by the sea-truth and remote measurements. Spectral signatures were determined to allow specific identification of sludge plumes. Multiple regression techniques, including stepwise regression analysis, were used to reduce the remote sensing data. The statistical analyses indicated that calibrated regression equations were adequate for mapping the sludge plume by remote sensing with respect to suspended solids. For chlorophyll-a, however, interference with analyses and plume mapping was attributed to possible fluorescent characteristics of the waste water dump material. Comparison of data obtained for line and spot plumes revealed similar spectral characteristics.

E040

STUDY OF POLYSACCHARIDES IN ACTIVATED SLUDGE MUCILAGE (Etude des polyosides du mucilage des boues activees),

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Station de Technologie Alimentaire,
Villeneuve d'Ascq, France.

Water Research, Vol. 10, No. 11, p 999-1003, 1976. 6 fig, 18 ref.

Activated sludges from the treatment of municipal and industrial waste water were used in experiments to isolate the polymer or polysaccharide fraction in sludge. The studies revealed that carbohydrates and related compounds such as galacturonic acid and rhamnose were partially incorporated in the activated sludge mucilage. Extracellular polymers or exopolysaccharides were synthesized during the contact period of contact-stabilization and were assimilated during sludge stabilization. Morphological features of the floc particles, as in the case of filamentous bulking, are said to be related to the activated sludge polysaccharides.

E041

POLYCYCLIC AROMATIC HYDROCARBONS IN AGRICULTURAL SOIL (Polyzyklische, aromatische Kohlenwasserstoffe in landwirtschaftlich genutzten Boden),

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Mainz, West Germany.

Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Abteilung 1: Originale, Reihe B, Vol. 164, No. 5-6, p 469-475, 1977. 2 fig, 3 tab, 19 ref.

Since sewage sludge used to amend agricultural soils may contain considerable amounts of polycyclic aromatic hydrocarbons (PAH), studies were conducted to establish baseline concentrations of these substances in soils. Fifty soil samples were collected at various locations throughout West Germany and analyzed for six PAH forms, including fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, and indeno (1.2.3-cd)pyrene. The average concentration of benzopyrene for 74% of the samples ranged from 2-50 ppm, while the total PAH concentration was 50-500 ppm. Higher values were attributed to extraneous sources of PAH. Previous studies on the concentration of benzo(a)pyrene in soils are reviewed.

E042

DISSOLVED SOLIDS IN WASTEWATER,

Klei, H. E., Sundstorm, D. W., and Perna, A. J.

AIChE Symposium Series, Vol. 73, No. 166, p 380-383, 1977. 2 tab, 11 ref.

Characteristics of dissolved solids in municipal and industrial waste waters are reviewed. Total dissolved solids concentrations are normally measured by evaporation to dryness of the filtrate obtained after passing the sample water through a 0.2-0.45-micron membrane filter. Since most industries contribute heavily to the total dissolved solids concentration of combined municipal and industrial waste, pretreatment of an industrial waste by ion exchange or reverse osmosis is suggested. Expected concentrations in municipal waste water of total, volatile, and fixed dissolved solids and of various contributing cations, anions, and organics are listed in tabular form. Components of industrial waste water are listed according to the particular type of industry.

E043

TESTS FOR NITRIFYING AND DENITRIFYING ABILITY OF ACTIVATED SLUDGE,

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Albany, New York.

Bulletin of Environmental Contamination and Toxicology, Vol. 18, No. 5, p 558-564, 1977. 6 ref.

Analytical procedures are presented for the quantification of the bacterial mass of a single-stage activated sludge system designed for carbonaceous contaminant removal, nitrification, and denitrification. The test for nitrifying ability is based on the respiration activity of Nitrosomonas. The substrate-mediated test is conducted at an ammonia-N concentration greater than 2.5 mg/liter to provide for a zero order reaction. The test is 1 hr in length and is conducted on mixed liquor rather than on return sludge. The pH is optimized and mass transport difficulties are eliminated by placing the heterotrophic bacteria in a state of endogenous respiration and by increasing turbulence and dilution. The test for the percentage of denitrifying bacteria in mixed liquor solids is based on endogenous nitrate respiration and is conducted on deoxygenated return sludge. Deoxygenation is accomplished by the addition of sodium thiosulfate and anaerobic conditions are maintained throughout the experiment. The denitrifying ability is based on the NO3/NO2-N ratio.

E044

VENTURI FLUMES AND REQUIREMENTS FOR MEASUREMENTS TECHNIQUES FOR EXACT MEASUREMENTS OF QUANTITIES OF WASTE WATER (Venturikanaele und messtechnische Anforderungen fuer genaue Abwassermengen),

Zuellig, H.

Zuellig AG Rheineck, Apparatebau fuer die Wasserwirtschaft,
Rheineck, Switzerland.

Wasser, Energie, Luft, Vol. 69, No. 5, p 111-115, 1977. 9 fig, 4 ref.

Venturi flumes and flow measurement techniques are described with respect to waste water flow measurements at treatment facilities. Venturi flumes with U or hexagonal profiles and parabolic or trapezoidal throats are best for exact measurements, especially at low flow velocities. The required accuracy of the flow measurement (+ or - 0.25% of the end value) can be achieved by the air bubble or sonic depth finder methods.

E045

THE COMPARABILITY OF OXYGENATION CAPACITY MEASUREMENTS (Vergleichbarkeit von Sauerstoffeintragsmessungen),

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und Abfallwirtschaft der Universitaet Stuttgart,
Stuttgart, West Germany.

Wasserwirtschaft, Vol. 67, No. 6, p 168-174, 1977. 5 fig, 6 tab, 7 ref.

Observations on oxygenation capacity and oxygen demand of sewage are presented for use by consulting engineers and planners in the design of sewage treatment plant equipment used for aeration. Observed values for oxygenation capacity and oxygen uptake were compared with values predicted by aeration equipment manufacturers. Surveys indicated that there were often wide differences in oxygen input and actual uptake by sewage. Temperature and the degree of mixing partially explain the discrepancies. Possible sources of measurement error are described.

E046

DETERMINATION OF HEAVY METALS IN SEWAGE-BASED FERTILIZER USING SHORT-LIVED ISOTOPES,

Egan, A., and Spyrou, N. M.

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England,
Department of Physics.

Journal of Radioanalytical Chemistry, Vol. 37, No. 2, p 775-784, 1977. 3 tab, 18 ref.

A fully instrumental method of neutron activation analysis is presented for use in the analysis of heavy metals present in sewage sludge. Objectives of the project under which the procedure was devised included the development of a means of analysis based on a fixed experiment time per sample, non-destructive irradiation and count, fully instrumental data collection, standard computing procedure, absolute determination of microgram quantities, and accuracy compatible with sampling uncertainties. The method which was developed is based on short-lived isotopes and requires a total experiment time of 1 hr per sample. Cyclic irradiation based on the period of radiation to measure 207 Pb (T=0.8s) was used to activate the samples. Gamma ray spectral data obtained by the Ge(Li) detectors were transferred to magnetic tape and analyzed by the SAMPO spectral analysis program. Modifications to the SAMPO program included the addition of an IDENTIFY subroutine which included a library of peaks for identification followed by a quantitative determination of the mass of the target element, eliminating the need for standards. Sample and standard preparation, irradiation and counting conditions, sensitivities and detection limits, and data-processing methods are presented.

E047

PHOTOMETRIC DETERMINATION OF TOTAL PHOSPHATE WITH HYDRAZINE-MOLYBDIC ACID REAGENT (Photometrische Bestimmung des Gesamtphosphats mit Hydrazin-Molydaensaeure-Reagenz),

Beyer, A.

Chemisch-biologische Laboratorien der Stadt Duesseldorf,
Dusseldorf, West Germany.

Gas- und Wasserfach, Wasser-Abwasser, Vol. 118, No. 7, p 327-332, 1977.
6 tab, 5 ref.

A photometric method for the determination of the total phosphate content in water is described. After treatment with sulfuric acid, the condensed phosphoric acid is hydrolyzed to orthophosphoric acid by boiling with distilled water. The acid is neutralized, and a 40-ml sample is successively combined with 1 ml of 2% citric acid and 9 ml of hydrazine sulfate-molybdic acid reagent. The flask is heated in a boiling water bath for 30-60 min to develop the colored complex. The extinction is measured at room temperature against a blank sample of distilled water treated in the same manner. The method permits the accurate and reproducible determination of 4-260 micrograms PO(4) per 40 ml. Heavy metal ions and silicic acid do not falsify the results. Chromate reduces the readings at concentrations of about 15 mg/liter and over. Sulfuric acid up to 0.25 g/40 ml has no influence on the result. Nitrate has to be destroyed when present in concentrations exceeding 2.5 mg/liter.

E048

DESIGN AND CONSTRUCTION OF AN ACTIVATED SLUDGE PLANT,

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Cleveland, Ohio.

AIChE Symposium Series, Vol. 73, No. 167, p 78-85, 1977.

In the development of an activated sludge treatment facility, the construction of a final detailed design, preparation of plans and specifications, construction of the facility, and initiation of operation generally follow the establishment of design criteria and process flow sheets. An effective final design is dependent on the engineer's accurate interpretation of design criteria and on the selection of the proper equipment and constraints. Various tasks which must be completed before a final detailed design is possible are outlined. The selection of process units is usually based on the constraints set by the material to be handled, the degree of performance requirement, and operation and maintenance requirements along with economic considerations and the designer/owner preference. Pumping systems, clarification, aeration, and other process stages are discussed with respect to process units. The construction of process and instrumentation diagrams is suggested to provide an overview of the plant early in the project. Coordination of the detailed design with operations and construction is discussed.

E049

POLLUTION MONITORING WITH TOTAL ORGANIC CARBON ANALYSIS,

Chandler, R. L., O'Shaughnessy, J. C., and Blanc, F. C.

Northeastern University,
Boston, Massachusetts,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 12, p 2791-2803, December, 1976. 11 fig, 2 tab, 4 ref.

A TOC analyzer which oxidizes organic carbon in the sample to CO2 and then reduces the CO2 to CH4 was used in experiments to evaluate the use of TOC as an indirect measure of BOD and COD in domestic and industrial waste water treatment and river quality monitoring. Correlations between BOD, COD, and TOC are described. Experiments with municipal waste water indicated that there was a significant correlation between 5-day BOD and TOC for samples from a specific location within a treatment process. In general, the correlation between TOC and 5-day BOD in domestic secondary effluents was greater than the relationship between TOC and COD. Regression equations for nitrification-inhibited and noninhibited 5-day BOD yielded values which were significantly different at the 0.10 level. Analysis of TOC measurements is also suggested to evaluate activated carbon for advanced waste water treatment, to monitor substrate-removal batch-treatability studies, and to monitor industrial waste water for fluctuations in strength. The correlation between 5-day BOD and TOC in river water was significant at the 0.01 level, although this decreased as the river approached higher flow conditions. TOC measurements are reported as unaffected by a sample storage period of 1 wk, provided the samples are acidified, capped, and refrigerated.

E050

WATER RESEARCH INSTRUMENTATION: 2,

Journal of the Institute of Measurement and Control, Vol. 10, No. 10, p 364-365, October, 1977. 1 fig.

Various measurement techniques which were presented during an open house on May 4-6, 1977, at the Medmenhan Laboratory of the Water Research Centre in England are described. A non-contacting flowmeter for use in sewers has been developed by the Water Research Centre in conjunction with the Department of Control Engineering at the University of Bradford. Flow velocity is measured by means of photodetectors which detect turbulent patterns on the fluid surface. An ultrasonic method of flow velocity and suspended solids measurement being developed for use with influent sewage, mixed liquor, returned sludge, and surplus sludge is described. The Digidip, an instrument for measuring levels in sewers, combines the operating principle of an oscillating probe with the reliability of low power digital electronic circuitry. Sulfur hexafluoride has been used as a tracer gas in detecting leaks in sewer lines. Cross-correlation of leak noise by statistical comparison of the shape envelope from one microphone with that of another has also been used.

E051

WASTEWATER EFFLUENT DISCHARGE TO COOLING LAKES,

Taylor, R. D., Dailey, J. E., and Rohlich, G. A.

Texas University,
Austin,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 907-918, October, 1977. 7 fig, 1 tab, 14 ref, 2 append.

The large quantity of fresh water required for cooling lakes which are used to dispose of waste water from power plants, and the increasingly stringent regulations on discharge of municipal waste waters, have created interest in the use of treated municipal waste waters as makeup water in cooling lakes. Although waste water has been used in cooling towers, up to this point it has not been discharged directly to cooling lakes in the United States. Results of a field study at Lake Brauning, a man-made cooling lake near San Antonio, Texas, are presented. Much of the lake's makeup water is drawn from the San Antonio River which in itself contains a large portion of secondary effluent. The water quality and trophic state were monitored in Lake Braunig over a 12-month period. The program indicated that the lake was highly eutrophic, although still useful for recreational and power plant purposes. The dominant algal species within the ecosystem is suggested as the most important factor in the usefulness of a lake as a cooling water source. Problems associated with the full-scale discharge of waste water to cooling lakes include: carbonate scaling and dezincification of condensers, boiler water treatment, water quality limitation on recreational uses, and the quality of cooling lake effluent released to receiving waters.

E052

INACTIVATION OF ENTERIC VIRUSES IN WASTEWATER SLUDGE THROUGH DEWATERING BY EVAPORATION,

Ward, R. L., and Ashley, C. S.

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Albuquerque, New Mexico.

Applied and Environmental Microbiology, Vol. 34, No. 5, p 564-570, November, 1977. 3 fig, 6 tab, 23 ref.

The use of waste water sludge as a fertilizer or animal feed supplement is dependent on the ability to inactivate the pathogens in the sludge without reducing its economic value. Studies were conducted to examine the effects of dewatering on the inactivation rates of enteric viruses in sludge. Raw sludge from the Albuquerque sewage treatment plant in New Mexico was seeded before and after dewatering with Poliovirus type 1, coxsackievirus B1, and reovirus type 3. Dewatering was accomplished by evaporation at 21 C. Measurements of the loss of viral plaque-forming units during dewatering indicated that the recoverable infectivity of poliovirus decreased gradually until the sludge solids content reached 65%. During evaporation from 65 to 83% solids, the virus titer decreased by more than 3 orders of magnitude. This was attributed to irreversible inactivation since viral particles were observed to have released extensively degraded RNA molecules. The inactivation of poliovirus by dewatering is supported by the significantly slower inactivation rates observed for sludge seeded after drying. Similar behavior was observed with reovirus type 3 and coxsackievirus B1, suggesting that dewatering by evaporation may be a viable method of inactivating all enteric viruses in sludge.

E053

A MERCURY-FREE ACCELERATED METHOD FOR DETERMINING THE CHEMICAL OXYGEN DEMAND OF LARGE NUMBERS OF WATER SAMPLES BY AUTOCLAVING THEM UNDER PRESSURE WITH ACID-DICHROMATE,

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Water Research, Vol. 11, No. 9, p 801-805, 1977. 2 fig, 2 tab, 10 ref.

A simplified colorimetric method for measuring COD in waste water effluents and receiving waters was developed in response to a program initiated in 1972 by the National Swedish Environment Protection Board to assess the effects of tertiary treatment on receiving waters. The RR method, named for a Swedish abbreviation for the words waste water treatment plant and receiving body of water, has been adapted for use with either waste water or fresh water with a detection range of 10-300 and 10-100 mg O_2/liter, respectively. Details of the apparatus, reagents, and procedure are presented. Reagents include potassium dichromate, sulfuric acid, silver sulfate, ferrous ammonium sulfate, and a ferrion indicator solution. The method requires small sample and reagent volumes of 1.0 and 2.0 mls, respectively, and does not require mercury. The procedure includes the rapid addition of a mixture of all the reagents to the sample and autoclaving for 1 hr in flasks fitted with glass stoppers. Titration of the excess dichromate with ferrous ammonium sulfate and the ferrion indicator is used to calculate the COD from dichromate. Parallel analyses with the RR method and KMnO4 consumption of 318 samples from 14 waste water receiving lakes yielded a correlation coefficient (r) of +0.90. Possible interference is presented by chloride at concentrations greater than 1 g/liter.

E054

IDENTIFICATION OF END PRODUCTS RESULTING FROM OZONATION AND CHLORINATION OF ORGANIC COMPOUNDS COMMONLY FOUND IN WATER,

Kuo, P. P. K., Chian, E. S. K., and Chang, B. J.

Illinois University,
Urbana,
Department of Environmental Engineering.

Environmental Science and Technology, Vol. 11, No. 13, p 1177-1181, December, 1977. 7 fig, 4 tab, 22 ref.

Chlorination of the humic acid materials in the ultra-filtration (UF) retentate and of the fulvic acid materials in the reverse osmosis (RO) retentate of secondary effluents can result in the formation of potentially toxic halogenated organics. Studies were conducted on the effects of ozonation with and without ultraviolet irradiation on 2-propanol, acetic acid, and oxalic acid. These compounds have been identified as poorly removed by RO and activated carbon in municipal waste water treatment. Further studies examined the formation of volatile halogenated organics during chlorination and ozonation of the UF and RO retentates of municipal secondary effluent. The ozonation studies indicated that 2-propanol was oxidized to acetone which was, in turn, oxidized to acetic and oxalic acids. Ozonation of acetic acid yielded glyoxylic and oxalic acids. Ultraviolet irradiation significantly enhanced the removal of organics during ozonation, increasing the rate constant for organic carbon removal by a factor of 8 for 2-propanol and by a factor of 6 for acetic acid. Volatile halogenated organics detected in the chlorinated UF and RO retentates included: methylene chloride, chloroform, carbon tetrachloride, bromodichloromethane, chlorodibromomethane, and bromoform.

E055
CHEMICAL MONITORING OF SEWAGE SLUDGE IN PENNSYLVANIA,

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Journal of Environmental Quality, Vol. 6, No. 4, p 421-426, October-December, 1977. 1 fig, 1 tab, 26 ref.

A one-year sampling program of sewage from six Pennsylvania cities was initiated to determine the sampling procedures required for the chemical monitoring of sewage sludge destined for land application. The program emphasized techniques required for a municipal waste water treatment plant which treated combined domestic and industrial wastes. Bi-weekly samples were collected at each plant and analyzed for solids, total-N, NH4-N, P, K, Na, Ca, Mg, Al, Fe, NO3-N, Mn, Cd, Co, Cr, Cu, Ni, Pb, Zn, and pH. The data revealed that sewage sludge from every treatment plant varied significantly over time with respect to almost every composition variable. The differences in solid concentrations were greater between the different plants than in material from any given plant. In general, solids concentrations varied inversely with respect to changes in total-N. Although the variation in sludge composition was significant with respect to time, no seasonal trends were observed. Since the nitrogen concentration in sludge from all plants ranged from 1-36% of the dry solids and phosphorus ranged from 1-6%, the prediction of the fertilizer value of the sludge was considered impossible without continuous chemical analysis. Heavy metal concentrations, particularly Cd, were considered the limiting factor in the feasibility of land application of the sludge since only 35% of the sludges analyzed were acceptable for application to cropland and 25% were in ranges which could adversely affect crop composition and the food chain.

E056
LEAK TESTING WITH DYED LIQUID TRACERS,

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Materials Evaluation, Vol. 35, No. 12, p 60-64, December, 1977. 6 ref.

Dyed liquid tracers have been used in a wide variety of applications, ranging from charting flow patterns in rivers to discerning leaks in pipelines. Flourescent dyes have been used as an alternative to non-flourescent visible color dyes which lose their tinctorial power rapidly by dilution. Fluorescent dyes, which can often be detected in extremely dilute solutions, generally fall into two categories: sensitizer dyes and color-former dyes. The sensitizer dyes exhibit strong fluorescence in thin films. The color-former dyes are normally used in conjunection with sensitizer dyes to shift the color response by cascading fluorescence. Bulk fluorescence is used in leak detection when the use of high tracer dye concentrations required for the thin-film mode is considered impractical. Dye tracers have been used to map water seepage in soil and to trace leaks in outfall sewers. Thin-film fluorescence has been used with extremely small leaks in encapsulated electronic components and lead-through wires. Heating units and evaporative dyes have been used in conjunction with micro-leaks associated with surface porosity. Dye tracers are available in oil-phase, water-phase, and gaseous forms. The various dyed liquid leak tracer materials and processes are summarized.

E057

COMPARISON OF MEMBRANES FOR FECAL COLIFORM RECOVERY IN CHLORINATED EFFLUENTS,

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Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2255-2265, November, 1977. 4 tab, 21 ref.

Various membrane-based techniques have been proposed for the enumeration of fecal coliforms in waste water effluents. Ten varieties of commercially available membranes were tested for their ability to recover fecal coliforms from chlorinated effluents. Grab samples of secondary and tertiary effluents were obtained from five Illinois waste water treatment plants. Statistical analyses of fecal coliform data obtained with the ten membranes revealed significant differences in performance. Membrane capabilities fell into four groups, with greater differences in fecal coliform recovery occurring between groups than within a group. The Millipore HC, Gelman GN-6, and Sartorius SM 138 06 (green) membranes yielded the highest fecal coliform recovery in chlorinated effluents, while the J-M radiation membrane gave the lowest recovery. Colony size also varied with respect to membrane type, with the Nuclepore membrane yielding the largest colonies. An average of 93.2% of the 1002 blue colonies isolated from all the filters was verified. Membrane characteristics and previous studies on factors which influence membrane performance are discussed.

E058
APPLICATION OF SEWAGE SLUDGE TO GARDEN PLOTS,

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Burlington,
Department of Microbiology and Biochemistry.

Compost Science, Vol. 18, No. 5, p 26-32, September/October, 1977. 6 fig, 3 tab, 20 ref.

Studies with corn, tomato, and beet crops were used to assess the response of garden crops to two levels of high-temperature, anaerobically-digested lime-amended sludge and one level of fertilizer. The effects of field addition of sewage sludge and fertilizer on plant yields and tissue elemental content were evaluated under local environmental conditions. Sludge application rates were based on the assumption that half of the nitrogen present in the sludge would be available to the plant. A double application of sludge was used to observe possible toxicities of metal ions. Results of elemental analyses of anaerobically digested sludge and sludge-grown plants are presented. Corn plant yields from plots receiving the inorganic fertilizer were essentially the same at all sludge application rates. For those plots which did not receive the inorganic fertilizer, yields were greatest with the double application of sludge. Gross yields of tomato plots were largest in terms of the number of fruit from the plot which received a double application of sludge and the inorganic fertilizer. The average weight per tomato was greatest from the plot which received the inorganic fertilizer but no sludge. Beet plant weight was much higher from those plots which received the inorganic fertilizer, irregardless on the amount of sludge applied. Iron and potassium deficiencies were exhibited by plants from some of the sludge-amended corn plots. Although tests for bacterial and viral pathogens in the amended sludge were negative, some transmission of soil bacteria by splashing onto corn stalks was observed.

E059
IMPROVED DETERMINATION OF SPECIFIC RESISTANCE TO FILTRATION (Determination amelioree de la resistance specifique a la filtration),

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Techniques et Sciences Municipales-L'Eau, Vol. 72, No. 2, p 59-60, February, 1977. 3 fig, 1 tab, 2 ref.

The validity of using specific resistance as a descriptive parameter for filtration of waste sludges has been questioned because of the dispersion coefficient inherent to the method. The method could be improved by calculating the mean value from a multitude of parallel determinations. Equations are given for measurement techniques, stressing the importance of the flow gradient. Automatic measuring devices are recommended as the most accurate means of determining specific resistance to filtration. Optimization of filtration analysis has been accomplished by an instrument which can be used for filtration as well as for recording resistance data.

E060

THE COMPARISON OF SLUDGE EXTRACTS AND CHU 10 IN CULTIVATING CHLORELLA PYRENOIDOSA,

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Department of Biology.

Chemosphere, Vol. 6, No. 9, p 581-588, 1977. 3 fig, 1 tab, 14 ref.

Increasing demands on the world's food supplies have led to various studies on the culturing of green algae as a source of protein. Experiments were conducted at the Chinese University in Hong Kong to evaluate the use of sewage sludge extracts as opposed to the Chu 10 medium for cultivating Chlorella pyrenoidosa green algae. Samples of sewage sludge were obtained from the University's treatment plant and extracts were prepared in concentrations of 1, 2, and 3%. Cell counts, chlorophyll, protein, and heavy metals were measured in Chlorella cultures. The growth rate in 1% sludge was higher than at other sludge concentrations and was also higher than in Chu 10. The cells cultivated in the 2% sludge extract had the highest chlorophyll content. The protein content in Chlorella cells fluctuated with time, regardless of the medium. Heavy metal concentrations were higher in the sludge-grown cells than in the Chu 10 variety. Since from 10 to 15% of the heavy metals in the sludge extracts were removed during culturing, the use of Chlorella pyrenoidosa is suggested as a possible means of waste water purification.

E061

ACCLIMATION OF FATHEAD MINNOWS AND LAKE TROUT TO RESIDUAL CHLORINE AND BROMINE CHLORIDE,

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Department of Zoology and Physiology.

Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2172-2178, October, 1977. 3 tab, 17 ref.

Previous studies on the effects of the total residual chlorine (TRC) and total residual bromine chloride (TRBC) in waste water effluents on aquatic life have suggested that fish are able to tolerate higher levels if levels are initially low and gradually increased. Experiments were conducted at the Grandville, Michigan, waste water treatment plant to determine if fathead minnows and lake trout previously exposed to TRC or TRBC could acclimate and survive in effluents having TRC or TRBC levels above their respective 96-hour TL50 values. The experiments also examined the 7-day survival rate of fathead minnows at maximum TRC levels after previous exposure to sub-lethal levels. The relationships between acclimation time, concentrations of TRC during acclimation, and degree of acclimation achieved by fathead minnows were determined. Results indicated that fathead minnows and lake trout with previous exposure to TRC or TRBC for more than 2 hours did acclimate more readily to chlorinated or chlorobrominated effluents. A linear relationship was observed between previous exposure and tolerance to residual halogen levels in excess of 96-hour TL50 values. Prior exposure to TRC for 4 hours or longer created greater tolerances to TRC in fathead minnows. High TRC concentrations were lethal, regardless of previous exposure history.

E062

OPERATION AND MAINTENANCE OF POLLUTION CONTROL EQUIPMENT,

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Pollution Engineering, Vol. 9, No. 12, p 52-55, December, 1977. 1 fig, 2 tab, 1 ref.

Proper maintenance techniques for the efficient operation of pollution control facilities are outlined. Initially, the guidelines recommend an inventory of all equipment by maintenance crews or outside consultants. A monthly maintenance report is suggested as a record of servicing, failures, and costs. Maintenance of the activated sludge system involves the recognition of problems such as sludge bulking, erratic sludge volume, difficulty in maintaining balanced mixed liquor and dissolved oxygen in aeration tank, and excessive foam in aeration tanks. The establishment of a floating maintenance man or crew for regional area air pollution equipment is recommended. Routine maintenance of incineration equipment is advised for preventing major breakdowns. Regulations governing sanitary landfill use and maintenance and a routine check of potential problems are suggested.

E063

A SIMPLE SOIL PERCOLATION TEST DEVICE FOR FIELD ENVIRONMENTALISTS,

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Environmental Health, Vol, 40, No. 3, p 138-139, November-December, 1977. 6 fig, 3 ref.

A simple float meter has been designed to provide accurate, reliable and systematic soil percolation data for sewage disposal site evaluations. The device consists of a styrofoam float, aluminum float rod, PVC float housing tube, and plastic end cap. It allows technicians to run several tests simultaneously. The float meter yields uniform, precise and reproducible test results. The float is placed in a hole at the test site and marked with tape. After the hole is filled with water and the initial level marked, level markings are registered for three consecutive time intervals once the water level decrease becomes consistent. The device can be constructed for about $10. More than one float meter can be used to conduct several simultaneous tests.

E064

METHODS FOR MEASURING THE DEGREE OF STABILITY OF AEROBIC STABILIZED SLUDGES,

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Oslo, Norway.

Water Research, Vol. 11, No. 9, 1977. 7 fig, 6 tab, 18 ref.

Various parameters which can be used to assess the degree of stability of aerobically processed raw sludges were identified and then used to devise a definition of fully stabilized sludge. Sludges were termed fully stabilized after 14 days of storage at 20 C, providing the Odor Intensity Index did not exceed 11 at any time. Stabilized sludges having a 'soil' odor were not considered objectionable. Insufficient sludge aeration and detention periods contributed to an increase in the odor intensity. As long as temperature effects were considered, oxygen uptake rates were also deemed suitable measurements of stability. Nitrate concentrations in aerobic stabilized sludge were also suggested as a measure of stabilization. Both oxygen uptake and nitrification were judged to be reliable parameters of stability for primary sludge, mixed-primary, chemical sludge, and septic tank sludge. BOD and COD reductions, pH changes, volatile suspended solids contents, and lead acetate tests were not considered adequate parameters for measuring sludge stability.

E065

OCCURRENCE OF ASPERGILLUS FUMIGATUS DURING COMPOSTING OF SEWAGE SLUDGE,

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Applied and Environmental Microbiology, Vol. 34, No. 6, p 765-773, December, 1977. 1 fig, 3 tab, 48 ref.

The presence of Aspergillus fumigatus, a fungus which affects the respiratory system, was investigated in sludge, compost, woodchips, and commercial potting mediums. A. fumigatus was detected in all stages of composting; high levels were especially prevalent in crude and screened compost and in stored woodchips from stockpiles older than one month. Levels of the fungus decreased significantly with an increase in the age of the stored compost, yielding negligible levels in compost stored more than six months. Sludge samples indicated that soil type and location could influence A. fumigatus. Levels detected in commercial potting soils varied from undetectable traces to amounts comparable to those detected in one-month-old storage compost. Temperatures greater than 60 C in compost limited the growth of A. fumigatus significantly. Airborne spores of the fungus were more abundant in compost sites exposed to air than in noncompost sites, a finding that supports the need for caution by treatment facilities employees with histories of respiratory problems.

E066

DISCOVERY OF AN AGENT IN WASTEWATER SLUDGE THAT REDUCES THE HEAT REQUIRED TO INACTIVATE REOVIRUS,

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Applied and Environmental Microbiology, Vol. 34, No. 6, p 681-688, December, 1977. 4 fig, 6 tab, 25 ref.

A viricidal agent contained in both raw sludge and anaerobically digested sludge was discovered and analyzed. The agent was shown to inactivate reovirus, a genus of enteric viruses found in human waste. The viricidal agent was not isolated or identified, but several of its properties were discovered through laboratory experiments. The agent was associated with waste solids but could be washed from the sludge solids with water. Viricidal activity in the sludge increased at pH 8-10 but was not observed at a pH lower than 6. The antivirus agent was assumed to be insoluble in acidic solutions. Temperatures greater than 35 C increased the rate of reovirus inactivation by the agent. The viricidal agent was inactivated at a temperature of 350 C sustained for 30 minutes, indicating its organic nature. The antiviral qualities of the agent significantly increased in the temperature range of 45 C. Heat inactivation of reovirus occurred more frequently in anaerobically digested sludge than in raw sludge. The alkaline properties of the anaerobically digested sludge were considered more conducive to the activation of the viricidal agent than the acidic nature of raw sludge. Ammonia, a compound which retards the activity of poliovirus, did not appear to be the viricidal agent as reovirus was unaffected by ammonia at 47 C. The agent did not inactivate poliovirus and may be the sludge component which protects poliovirus from heat inactivation.

E067

THE EFFECT OF TOXIC LOADS ON EFFLUENT PURIFICATION SYSTEMS,

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Water SA, Vol. 3, No. 2, p 83-89, April, 1977. 12 fig, 3 tab, 4 ref.

An attempt was made to correlate performance data from the Stander Water Reclamation Plant and various biological treatment plants and pilot plants at the Daspoort Sewage Works in Pretoria, South Africa, for a period in 1975 when efficiency was reduced. The deterioration in performance was attributed to the presence of toxic substances in the sewage. Unusually high concentrations of mercury, phenol, chromium, and an organophosphorus compound were detected. Any of these substances or a combination of them might have caused the reduced efficiency. Reactors which employed attached biological growth were affected more than the extended aeration activated sludge processes. Biofilter effluents had high bacterial counts due to encystation by peritrichous ciliates. Nitrification, which declined rapidly during late July and early August, was still not recovered completely by the middle of October. The effect on COD removal was more limited. Biological treatment following lime flotation was unaffected, suggesting that prior lime addition protected the biological processes. The high quality of the water from the Stander Water Reclamation Plant remained the same, even when the quality of influent from the biological treatment facilities was not substantially improved over that of settled sewage.

E068

GROWTH OF LOBLOLLY PINE SEEDLINGS IN STRIP-MINED KAOLIN SPOIL AS INFLUENCED BY SEWAGE SLUDGE,

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Journal of Environmental Quality, Vol. 6, No. 4, p 379-381, October-December, 1977. 2 tab, 11 ref.

A study was carried out to determine whether adding sewage sludge to kaolin spoils would improve growth of loblolly pine seedlings. The minimum quantity of sludge addition needed to significantly increase growth and the maximum quantity that could be used without reducing growth were also determined. Loblolly pine seedlings were transplanted and grown for 6 mo in strip-mined kaolin spoil amended with different amounts of dry sludge. Seedlings on spoil amended with the equivalent of 34 metric tons of sludge/ha were 49% taller, 79% greater in stem diameter and had a 126% greater fresh weight than seedlings grown without sludge. The percentage of short-roots having ectomycorrhizae was higher for seedlings grown with 34 and 69 metric tons of sludge/ha than for those grown in spoil which received 0, 138, or 275 metric tons/ha. Chemical analyses showed significantly greater amounts of residual organic matter and elements essential for plant growth in sludge-amended kaolin spoil than in non-amended kaolin spoil. Land application of sewage sludge as a soil conditioner was considered advantageous because of its dual purpose in waste disposal and land reclamation. The addition of even small amounts of sludge to the kaolin spoils produced a significant increase in the growth rates and the extent of mycorrhizal development by the loblolly pine seedlings.

E069

LAND APPLICATION OF SEWAGE SLUDGE: V. CARBON DIOXIDE PRODUCTION AS INFLUENCED BY SEWAGE SLUDGE AND WOOD WASTE MIXTURES,

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Department of Soil Microbiology.

Journal of Environmental Quality, Vol. 6, No. 4, p 446-451, October-December, 1977. 6 fig, 4 tab, 20 ref.

Studies were conducted to examine the effect of different proportions and rates of application of wood residues and sludge on the rate of CO2 production. Wood, bark, and a wood-bark mixture from Engelmann spruce were added to

anaerobically digested sludge in varying proportions. Each mixture was applied to a clay loam at a rate of 22.4-224 metric tons/ha. The carbon oxidation rate was assessed using carbon dioxide production over a period of 367 days. Generally, carbon dioxide production increased as application rate increased, but the increase was not additive for most of the time intervals. At higher application rates, carbon dioxide accumulation increased as the percentage of wood and bark materials increased up to 75% bark or wood material, then dropped at 100% wood material. Laboratory incubation and greenhouse studies attempted to correlate carbon dioxide production with N mineralization. Microbial respiration was considered a suitable index of plant-available nitrogen in soil, except in cases where nutrients were deficient because of microbial immobilization or where toxic substances limited microbial activity.

E070

INVESTIGATION OF FILL AND BATCH PERIODS OF SEQUENCING BATCH BIOLOGICAL REACTORS,

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Water Research, Vol. 11, No. 8, p 713-717, 1977. 5 fig, 1 tab, 5 ref.

Operational difficulties with sequencing batch biological reactors have led to the more widespread use of continuous flow, constant volume treatment systems. Improvements in process control and the need for more reliable and consistent treatment have led to the need for a re-evaluation of biological treatment practices. Sequencing batch reactors provide equalization of flow and concentration, treatment of organics, and quiescent sedimentation. Reductions in volume are also expected from plug flow systems. Laboratory studies were performed to study waste removal, organism growth, and oxygen supply during the fill and batch phases of biological treatment. The mathematical model was derived for calculation of the waste and organism concentration and oxygen uptake rate with respect to time. Measured and predicted values agreed well. These results suggested that fill and draw reactors may provide a viable alternative to continuous flow treatment schemes.

E071

OZONE OXIDATION OF ORGANIC SEQUESTERING AGENTS IN WATER PRIOR TO THE DETERMINATION OF TRACE METALS BY ANODIC STRIPPING VOLTAMMETRY,

Clem, R. G., and Hodgson, A. T.

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Environment and Energy Division, Lawrence Berkeley Laboratory.

Analytical Chemistry, Vol. 50, No. 1, p 102-110, January, 1978. 6 fig, 3 tab, 27 ref.

Acids, normally used to destroy naturally occurring sequestering agents in water samples prior to trace metal analysis by anodic stripping voltammetry (ASV), can rapidly destroy the graphite electrodes used in the analysis. Ozone oxidation was evaluated as an alternative to acidification in the analysis of bay water and sewage effluents for Pb and Cd. Ozone is a strong oxidizing agent which has been observed to inactivate sequestering agents over a pH range of 2-10. Ethylenediaminetetraacetic acid (EDTA), ammonium pyrrolidine dithiocarbamate (APDC), tannic acid, and humic acid solutions were used to simulate the complexing agents present in sewage and natural waters. A corona discharge tube and a high-voltage transformer were used to generate ozone from oxygen which was introduced at a flow rate of 3 liters/min. Solutions containing 3 ppm EDTA, 25 ppm APDC, 25 ppm humic acid, 100 ppm tannic acid, and 20 ppb Cd and Pb were ozonized under acidic and basic conditions; and the relative metal recoveries were compared. Approximately 96% of the Cd and 99% of the Pb were recovered from a 100 ppm humic acid solution after 3 hours of ozonolysis. The adsorption of surface active compounds onto the graphite electrode produced a loss of sensitivity which increased in proportion to the length of contact time between the electrode and the sample solution. Ozonolysis was recommended for application to on-line ASV systems for measuring heavy metal concentrations in waste water effluents.

E072

THE APPLICABILITY OF TRACER TECHNIQUES FOR STUDIES ON SEWAGE TREATMENT PROCESS DYNAMICS,

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International Journal of Applied Radiation and Isotopes, Vol. 28, No. 10-11, p 833-837, 1977. 2 fig, 34 ref.

Radioactive isotopic tracers have been used to label particular elements, solid particles, and sludge for the examination of physical and chemical processes occurring during waste water treatment. The dilution method, the total count method, and the total sample method have been used to measure flow rates in channels or conduits having unknown flow cross-sections. When the flow volume and the degree of mixing between two designated points can be determined, the trace pulse velocity method is favored for measuring tube flows. Tracer techniques have been used to study sedimentation basin dynamics, to detect severe hydraulic malfunctions, and to compare sedimentation basin design efficiencies. Radioactive isotopic tracers have been used in the activated sludge process to determine the sludge recycling ratio, circulation time, and mixing requirements. Tracer methods have been developed for measuring the aeration capacity of an aeration basin under actual process conditions.

E073

THE APPLICABILITY OF PYROLYSIS-GAS-LIQUID CHROMATOGRAPHY FOR THE QUANTITATIVE IDENTIFICATION OF BACTERIA IN SEWAGE TREATMENT PLANT EFFLUENT,

Symuleski, R. A.

Dissertation Abstracts International B, Vol. 38, No. 7, p 3308, 1978.

Pyrolysis-gas-liquid chromatography (PGLC) was evaluated for the identification of bacteria in aqueous sewage effluent. PGLC analysis of bacteria reduced the identification time from the 24-27 hrs necessary for other methods to 1-2 hrs. Analysis at the strain level resulted in unique signatures of bacterial cells using the PGLC technique which could be detected at bacteria levels of about 80 colony-forming units in 100 ml of liquid. The chemical heterogeneity of the secondary treated waste analyzed resulted in more accurate qualitative results than quantitative. It was determined that PGLC analysis of homogeneous effluent would yield better quantitative results. Bacterial signatures calculated by PGLC were not dependent on the composition of the effluent. The method may also be applicable to the analysis of food, cosmetic, and pharmaceutical industry wastes. Signatures of bacteria detected in the effluent were matched with a data bank of species' signatures included in a computer program designed for the project.

E074

THE REDOX POTENTIAL OF ACTIVATED SLUDGE,

Burrows, M. G.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 4, p 415-422, 1977. 6 fig, 3 tab, 3 ref.

The redox potential of activated sludge was examined under laboratory and full-scale conditions using a platinum electrode with a Ag/AgCl2 reference electrode, a pH meter, and a recorder. Samples collected during three aeration cycles were monitored for EH, BOD, ammonia-nitrogen, nitrite, nitrate, dissolved oxygen, mixed liquor suspended solids, and pH. The rate of change of the sludge redox potential during aeration was directly related to the concentration of mixed liquor suspended solids and the rate of aeration of the activated sludge. The redox potential increased further with the preconditioning of the sludge through aeration cycles. The establishment of nitrification was also found to result in an increase in the plateau level of the redox potential. A higher potential was considered better for activated sludge processes. Redox potentials were monitored at an activated sludge facility which was subject to variations in loading and at a diffused air activated sludge treatment plant which produced a 30:20 standard effluent. It was discovered that redox potential was related to loading variations, with a 12-hour delayed effect. Low quality effluent was produced at lower redox potentials, while a higher redox potential enhanced nitrification.

E075

BIODEGRADATION OF ORGANIC SUBSTANCES BY BIOLOGICAL TREATMENT AND IN NATURAL WATERS (Gesuido shori jo oyobi kokyoyo suiiki ni okeru yukiodoku busshitsu no bunkai katei ni kansuru kenkyu),

Murakami, K., Hasegawa, K., Watanabe, H., and Komori, K.

Showa 51 Nendo Kankyo Hozen Kenkyu Seika Shu II, Vol. 1, No. 95, p 1-17, 1977. 24 fig, 8 tab, 3 ref.

Organic components which are resistant to waste treatment were identified and their properties investigated. Samples of secondary sewage effluent and receiving waters were exposed to aerobic, dark conditions at 20 C. It was found that the rate coefficient of decay by first-order reaction was greater for short-term decomposition of BOD than for COD due to manganese and total organic carbon. The decomposition rate for total organic carbon was greater than that of COD under the preceeding conditions, but both were approximated more accurately with longer decomposition periods and higher-order reactions. Using gel filtration chromatography, soluble organic compounds were categorized into two groups of biodegradable substances and two groups of nondegradable substances. Gel chromatographs were similar for polluted receiving water and secondary effluent and showed that the order of removal of compounds for size separation by gel filtration chromotography was based not on molecular weight, but on molecular structure and functional group. Aerobic decomposition of freshwater green and blue-green algae in lake water occurred within ten days during summer. The activated sludge process was effective in removing contributors to TOC which did not exhibit much ultraviolet absorbence at 260 nm.

E076

PARAMETER ESTIMATION FOR THE FIRST-ORDER BOD EQUATION USING NONLINEAR TECHNIQUES,

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Department of Civil Engineering.

Canadian Journal of Civil Engineering, Vol. 4, No. 4, p 462-470, December, 1977. 7 fig, 5 tab, 14 ref.

BOD parameters in waste water were calculated using two nonlinear techniques. The techniques were compared to other estimation methods by application of the techniques to raw sewage and primary effluent from the Waterloo Pollution Control Plant in Ontario, Canada. The first technique used in estimating the parameters in first-order BOD equations was the Reilly discrete Bayesian technique. This method was preferred for calculating BOD parameters in situations where there was a considerable amount of operating data and a relatively small amount of experimental data. The Reilly discrete Bayesian technique, which successfully incorporated prior data into the BOD parameter estimation method, was shown to be satisfactory when other simpler techniques produced inadequate results. The second method of estimating firsr-order BOD parameters was Marquardt's nonlinear least-squares technique. This algorithm was found to produce results comparable to the Bayesian method and to require less time for computer calculations. While Marquardt's method was considered simpler and less expensive than the Bayesian technique, various problems, such as slow convergence, wide oscillations, and failure to converge, did occur. Two nonlinear techniques tested were considered better than the other techniques which had incorrect error structures.

E077

METALS IN URBAN DRAINAGE SYSTEMS AND THEIR EFFECT ON THE POTENTIAL REUSE OF PURIFIED SEWAGE,

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Water SA, Vol. 1, No. 1, p 36-43, April, 1975. 2 fig, 7 tab, 11 ref, 1 append.

Methods were examined for the removal of heavy metals from waste water to allow recovery of potable and industrial water in South Africa. Tests conducted at four South African sewage treatment plants indicated that a major percentage of the copper, chromium, cadmium, lead, zinc, and iron in the waste water accumulated in the sludge after treatment. Significantly lower concentrations of nickel and manganese were removed during the treatment process. A comparison of South African Bureau of Standards' limits for heavy metals in drinking water with maximum concentrations observed over a one-year period in treated water from the four sewage plants indicated that concentrations of lead and chromium frequently exceeded drinking water standards. Precipitation of heavy metals from waste water with lime was found effective when the metals were present as salts. Further treatment was necessary for hexavalent chromium and cyanide-metal complexes. Alum was found to be effective for the removal of heavy metals from pulp and paper industrial wastes. It was concluded that mercury limitations and stricter nickel concentrations should be established in South Africa but that other heavy metal standards were acceptable.

E078

FACTORS AFFECTING EFFLUENT QUALITY FROM FILL-AND-DRAW ACTIVATED SLUDGE REACTORS,

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Environmental Engineering Laboratory.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2390-2396, December, 1977. 1 fig, 4 tab, 12 ref.

The concentration of soluble organic matter in effluent treated by the activated sludge process was compared with the concentration of organic matter in waste water before treatment. The influence of hydraulic residence time on the quality of the effluent was also observed. Experiments were conducted using plug-flow activated sludge reactors with influent lactose concentrations ranging from 600-3,600 mg/liter. Hydraulic residence times were held constant at 46 hours with the fill-and-draw cycle occurring every 24 hours. Daily samples were analyzed for suspended solids, volatile suspended solids, pH, COD, and lactose. Soluble COD concentrations in the effluent were found to be directly related to the soluble COD content of the influent. This proportional influence of influent concentration on effluent quality in a plug flow activated sludge system was found to be the same result as obtained in experiments with completely-mixed processes. Soluble COD in the effluent was produced by microbial action during the activated sludge process. It was concluded that the COD concentration of the influent determined the effluent quality, regardless of the hydralic process, and that the activated sludge method not only used organic matter, but produced it as well. The effect of the hydraulic residence time on effluent quality could not be determined.

E079

THE USE OF FAECAL BACTERIA AS A TRACER FOR SEWAGE SLUDGE DISPOSAL IN THE SEA,

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Fisheries Laboratory,
Burnham-on-Crouch, Essex, England.

Marine Pollution Bulletin, Vol. 8, No. 12, p 283-285, December, 1977. 2 fig, 4 ref.

The movement of sewage sludge discharged into Liverpool Bay in England was followed using bacteria indigenous to sewage as a tracer. Enumeration of E. coli and other enterobacteria associated with fecal waste was accomplished within two days for samples of bottom sediment collected from 62 sites in Liverpool Bay. Initial concentrations of coliforms in the sediment samples proved higher than E. coli concentrations, indicating greater survival of coliform bacteria over a large area. Movement of the bacteria demonstrated a definite easterly direction towards the River Mersey and rising tide; little northerly or southerly movement was observed. Previous studies with radioactive tracers had yielded similar results and indicated rapid dispersion with east-west settlement over an area 8-km wide by 30-km long. Fecal bacteria was found to collect in muddy sediments and had a short viability in seawater.

E080

A MICRO-KJELDAHL TECHNIQUE FOR NITROGEN DETERMINATION IN WATER, WASTEWATER, AND SLUDGE,

Stephenson, R. L.

Butler, Fairman and Seufert, Incorporated,
Carmel, Indiana.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2499-2502, December, 1977. 2 tab, 5 ref, 1 append.

A modification of the micro-Kjeldahl technique was developed as a simplified method of measuring the nitrogen content in waste water, sludge, and water. A 5-ml sample containing ammonia nitrogen is subjected to a temperature of 340 C, producing ammonium bisulfate and ammonium sulfate. The sample is diluted after digestion with ammonia-free water and its pH is raised to 10 with the addition of sodium hydroxide. The nesslerization technique is used to calculate the ammonia nitrogen concentration in the sample. The simplified technique was tested in laboratory experiments with four representative amino acids: glycine, methionine, tryptophan, and diphenylcarbazone. The nitrogen concentrations of the samples were 500, 250, 50, and 10 mg/liter. Nitrogen recovery from glycine, used to represent a monoamino monocarboxy acid, ranged 92-100%. Nitrogen recovery with methionine, used as a long-chain, sulfur-containing amino acid, ranged 96-124%. Tryptophan, as a heterocyclic acid, exhibited recoveries of 100-106%. Diphenylcarbazone, insoluble in acid solutions, showed poor recovery of nitrogen, ranging 8.4-120%.

E081

A FAECAL STEROL SURVEY IN THE CLYDE ESTUARY,

Goodfellow, R. M., Cardoso, J., Eglinton, G., Dawson, J. P., and Best, G. A.

Bristol University,
England,
Department of Chemistry.

Marine Pollution Bulletin, Vol. 8, No. 12, p 272-276, December, 1977. 2 fig, 5 tab, 21 ref.

Various tracer techniques have been used to map the movement of sewage effluents discharged from ocean outfalls. In this study, gas chromatography was used to measure levels of coprostanol in water and sediments collected in the Clyde estuary and Firth of Clyde in England. Bottom sediments contained 0.1-14.0 ppm of coprostanol (5beta-cholestan-3beta-ol), as well as the corresponding 24-methyland 24-ethyl-5beta-stanols. The concentrations of coprostanol in seawater closely parallelled fecal coliform counts obtained for the seawater samples. Coprostanol levels were also directly related to the discharge locations and quantities of sewage input to the estuary by sewage outfalls and dumping operations. The data indicated that fecal steroid levels in sewage were rapidly diluted after discharge, although they could be detected in surface waters over 20 km from the sewage outfalls. The results suggested that coprostanol data might be used in addition to fecal coliform enumeration for monitoring the path of pollutants, especially for detecting domestic wastes in industrial outfalls where the concentration of sewage bacteria is generally low.

E082

DISTRIBUTION OF VIRAL AND BACTERIAL PATHOGENS IN A COASTAL CANAL COMMUNITY,

Gerba, C. P., Goyal, S. M., Smith, E. M., and Melnick, J. L.

Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Marine Pollution Bulletin, Vol. 8, No. 12, p 279-282, December, 1977. 1 fig, 3 tab, 18 ref.

In canal communities, each house has canal frontage allowing direct water access. The occurrence and distribution of bacterial and viral pathogens were examined in a canal community on the Texas Gulf coast where secondary-treated sewage effluent was discharged. Turbidity and salinity, as well as bacteria and viruses, were measured. Sewage from the community is treated in a small activated sludge plant which discharges an unchlorinated effluent. Recommended limits of 1000 total coliforms/100 ml and 200 fecal coliforms/100 ml for recreational water were exceeded in two of the three monthly samples. Salmonella, poliovirus, and Echovirus types 1, 2, and 3 were also isolated. Assuming an average virus concentration efficiency of 50%, the recommended standard for recreational water of one infectious unit of virus per 10 gallons was exceeded in all water samples.

E083

STUDIES ON THE TOXICITY OF AMMONIA, NITRATE AND THEIR MIXTURES TO GUPPY FRY,

Rubin, A. J., and Elmaraghy, G. A.

Ohio State University,
Columbus,
Department of Civil Engineering.

Water Research, Vol. 11, No. 10, p 927-935, 1977. 8 fig, 6 tab, 19 ref.

The toxicities of ammonia and nitrate, administered separately and in mixtures, on guppy fry were evaluated. Individual toxicities of ammonia and nitrate, two common constituents of treated waste water, were estimated in statis tests at constant pH and temperature. The 72-hour median lethal values were 199 and 1.26 mg/liter-N for potassium nitrate and free ammonia, respectively. The toxicities of mixtures of the two were additive, except at very low ammonia to nitrate ratios. Watson's equation, a disinfection law relating toxicant concentration to survival, was applicable to both toxicants. The applicability of Chick's law and other kinetic models to fish toxicity was also evaluated.

E084

INFLUENCE OF ARTIFICIAL DRAINAGE ON PENETRATION OF COLIFORM BACTERIA FROM SEPTIC TANK EFFLUENTS INTO WET TILE DRAINED SOILS,

Reneau, R. B., Jr.

Virginia Polytechnic Institute and State University,
Blacksburg, Virginia,
Department of Agronomy.

Journal of Environmental Quality, Vol. 7, No. 1, p 23-30, January-March, 1978. 4 fig, 6 tab, 14 ref.

The movement of fecal and total coliform bacteria through tile drained soil systems from domestic septic tanks was monitored with on-site analytical techniques in Windsor, Virginia. The residential study area was characterized by poorly drained Aeric and Typic Ochraquults soil that had been previously tile drained for agricultural purposes. Sampling monitors were oriented in the direction of the groundwater flow; water table control wells and tile outfalls were established at various distances from the three sites. Log normalized fecal coliform densities for high water tables reached a mean high of 160,000/100 ml in the third site at 152 cm from the septic source. Fecal counts for three sites at distances of 1,310, 1,341, and 2,172 cm from the sewage source were reduced to a minimum of less than 3.0/100 ml. The highest mean total coliform density recorded at site three of 730,000/100 ml at 152 cm was reduced to a density of 380/100 ml at the maximum distance from the source. A high of greater than 240,000/100 ml for total coliform density and a low of less than 3.0/100 ml for fecal coliform density were observed in the tile outfalls for high water tables. Coliform counts increased during the summer low water tables.

E085

CONSERVATION OF SAMPLES OF WASTE WATER BY COOLING (Konservierung von Abwasserproben durch Kuehlung),

Gudernatsch, H.

Wasser, Luft, und Betrieb, Vol. 21, No. 11, p 598-600, 1977. 4 fig, 2 tab, 7 ref.

The influence of sample treatment and storage temperature on the total organic carbon (TOC) and COD values of industrial and combined municipal-industrial waste waters was evaluated. Samples were collected at waste water treatment plants after the primary treatment stage and from the treated stream. Differences of not more than 10% in TOC and COD values measured in samples which had been subjected to various types of handling and storage were considered insignificant. The COD and TOC values obtained for most of the homogenized samples were significantly higher than those of filtered samples. The differences between sedimented and filtered samples were significant in 2 out of 8 cases only. Experiments on the effect of storage length and temperature revealed that storage at 20 C for more than 24 hours would result in erroneous TOC and COD data. Storage for up to 7 days at 4 C and for up to 28 days at -18 C did not affect TOC and COD determinations.

E086

PHOTOTROPHIC PURPLE AND GREEN BACTERIA IN A SEWAGE TREATMENT PLANT,

Siefert, E., Irgens, R. L., and Pfenning, N.

Institut fuer Mikrobiologie der Gesellschaft fuer
Strahlenund Umweltforschung mbH,
Goettingen, West Germany.

Applied and Environmental Microbiology, Vol. 35, No. 1, p 38-44, January, 1978. 2 fig, 5 tab, 19 ref.

The content and metabolism of phototrophic bacteria in waste water purification processes were investigated in laboratory experiments with effluent from the Goettingen, West Germany, sewage treatment plant. Phototrophic bacteria were evident in every stage of the treatment process; the bacteria count was highest in sludge-bearing waste water. Colony counts of purple nonsulfur bacteria in all stages of waste treatment ranged 100-650,000 colonies/ml of waste. Purple and green sulfur bacteria colony counts ranged 0-1,300/ml. The quantity of bacteriochlorophyll, synthesized by the purple nonsulfur bacteria, in activated sludge samples was found to be 5-10 times higher than the calculated production for the bacteria colony count. It was concluded that phototrophic bacteria continue to grow in a reduced oxygen environment. The reduction of light in activated sludge layers was not a growth-limiting factor for phototrophic bacteria. It was assumed that the bacteria continue to grow through respiratory energy at low oxygen concentrations. Phototrophic bacterial growth was limited, but not eliminated under anaerobic and dark conditions. Growth continued by fermentative energy metabolism, but not efficiently enough to allow competition with chemotrophic anaerobes. Although not considered as efficient as chemotrophic bacteria in waste water treatment, phototrophic bacteria had the advantage of assimilating inorganic minerals and producing cell protein as a byproduct. An example of waste water treatment with phototrophic bacteria in Japan was cited.

E087

DETERMINATION OF CHLORINE DIOXIDE IN SEWAGE EFFLUENTS,

Knechtel, J. R., Janzen, E. G., and Davis, E. R.

Wastewater Technology Center,
Burlington, Ontario, Canada.

Analytical Chemistry, Vol. 50, No. 2, p 202-205, February, 1978. 5 fig, 3 tab, 14 ref.

An spectrophotometric technique with acid chrome violet K decolorization was developed for the measurement of chlorine dioxide in waste water. Maximum absorbance of acid chrome violet K in a dilute solution with chlorine dioxide occurred at 550 nm. The chlorine dioxide content was measured after solids removal with a spectrophotometer at pH 8.1-8.4. A similar procedure was devised for the reaction of acid chrome violet K with chlorine, hypochlorite, chlorite, chloramine T, and nitrite to determine interference. Effluent samples were also analyzed for chlorine dioxide content with an electron spin resonance technique for verification of the acid chrome violet K data. Simultaneous analysis for chlorine dioxide with the colorimetric and the electron spin techniques was necessary because of the decay rate of chlorine dioxide. Both techniques gave similar chlorine dioxide values in sample tests.

E088

TRANSFER OF HEAVY METALS FROM SEWAGE SLUDGE TO FESCUE TO RAT TISSUES,

Miller, J., and Boswell, F. C.

Georgia Experiment Station,
Georgia University,
Experiment.

Federation Proceedings, Federation of American Societies for Experimental Biology, Vol. 37, No. 3, p 894, 1978.

Heavy metal absorption by organ tissues was examined in experiments with rats which had been fed diets of fescue which had been treated with secondary treated sewage effluent and with inorganic salts of minor elements. Established fescue crops were irrigated with sewage sludge from a highly industrialized city and treated with inorganic salts of cadmium, chromium, copper, iron, manganese, and zinc. A three week diet consisting of 50% fescue was fed to Sprague-Dawley rats. The rate of uptake of the heavy metals by the rats was dependent upon the source of the metal, effluent or inorganic salt, and upon the organ or system absorbing the metal. Liver and kidney accumulations of chromium from both types of treated fescue were similar in the rats; chromium uptake by fescue was five times higher from the sewage effluent than from the inorganic salts. Liver tissue of rats which had been fed cadmium salt-treated fescue contained 10 times more cadmium than the tissue of rats which received sewage-treated fescue. Cadmium uptake by fescue was the same with effluent irrigation and salt application. Liver size in the rats was found to increase, although there were no significant weight changes.

E089

THE EFFECTS OF SEWAGE SLUDGE ON THE GROWTH RATE OF CARP, CYPRINUS CARPIO L.,

Yip, S. W., and Wong, M. H.

The Chinese University of Hong Kong,
Shatin,
Department of Biology.

Environmental Pollution, Vol. 14, No. 2, p 127-132, 1977. 1 fig, 3 tab, 10 ref.

Cyprinus carpio (carp) were raised in tap water, sewage effluent, and various concentrations of digested sludge in laboratory experiments to determine the effects of waste on carp growth. Detritus-feeding carp were raised in sludge mixed with tap water at concentrations of 0.8, 0.6, 0.4, and 0.2%. The medium most conducive to carp growth was the sludge solution of 0.2%, followed by, in decreasing order, sewage effluent, tap water, 0.4%, 0.6%, and 0.8%. All the carp raised in the 0.8% sludge died within 2 weeks and a 50% mortality rate was observed in the 0.6% solution after 2 weeks, with only one carp surviving into the third week. Carp reared in sewage effluent and 0.2% sludge had greater dry weights and protein contents than carp grown in tap water or higher sludge concentrations. Phosphate concentrations in the media increased during the test period for sewage effluent, tap water, 0.2%, and 0.4% sludge. Media metal concentrations, including Cd, Cu, Fe, Mn, Zn, Ce, and Mg were analyzed. Metal contents of sewage effluent and the 0.2% sludge solution were similar and consistently lower than those of other media. Cr and Pb were only detected in sewage effluent. Metal levels in the higher sludge concentrations were considered harmful to the carp and the cause of fish mortality. It was suggested that asphyxiation resulted from a reaction of heavy metal ions with mucus in the fish gills, a phenomenon known as the coagulation film anoxia.

E090

A NEW METHOD OF MONITORING WATER QUALITY IN A STREAM RECEIVING SEWAGE EFFLUENT, USING CHIRONOMID PUPAL EXUVIAE,

Wilson, R. S., and McGill, J. D.

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England,
Department of Zoology.

Water Research, Vol. 11, No. 11, p 959-962, 1977. 3 fig, 20 ref.

Organic enrichment of the River Chew in England by sewage effluent was monitored by the on-site quantification of Chironomid pupal exuviae. Large populations of Chironomus riparius often predominate over other chironomid species in polluted water courses. The pupae of Chironomus riparius shed easily recognizable skins at the water's surface which float and are transported downstream. Samples of floating scum were collected at 11 stations along the

River Chew and Stoke Brook into which sewage effluent is discharged. Three of the sampling stations were upstream of a sewage outfall while the others were below it at a maximum distance of 1,040 meters from the discharge point. C. riparius exuviae were absent in samples taken 240 and 90 meters above the sewage outlet and comprised 1.0% of a sample collected 30 meters above the outfall. A maximum concentration of C. riparius skins of 62% was obtained for a sample collected 30 meters below the outfall. The concentration decreased consistently with distance from the effluent source. No pupae exuviae were evident in the sample obtained 1,040 meters below the outfall. An increase to 55% C. riparius cccurring 130 meters downstream was attributed to water obstruction by fallen branches which entrapped scum. Yearly sampling was suggested as a means of continuously monitoring the river quality.

E091

NEARSHORE SEDIMENT POLLUTION IN ISRAEL BY TRACE METALS DERIVED FROM SEWAGE EFFLUENT,

Amiel, A. J., and Navrot, J.

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Rehovot, Israel,
Department of Soil and Water Science.

Marine Pollution Bulletin, Vol. 9, No. 1, p 10-14, 1978. 5 fig, 9 ref.

Marine sediment from the Israeli coast in the vicinity of a sewage outfall was analyzed for silver, copper, chromium, cobalt, mercury, nickel, lead, and zinc. Both total and extractable trace metal measurements were recorded for sediment core samples. Trace metal concentrations were found to be a function of distance from the sewage outfall, with the highest accumulations recorded near the pipeline outlet. Significant trace metal concentrations were found within 400 meters from the shoreline and sewage pipe. Beyond the 400 meter distance, dilution reduced the trace metal concentrations. Dilution of bacteria was limited near the outfall and increased progressively with distance from the pipe. Trace metal concentrations in sediment collected at a significant distance from the outfall were similar to concentrations in non-polluted areas. Maximum trace metal levels were recorded during the summer months and in the upper layers of the sediment. A previous study of the outfall area indicated concentrations of cadmium and copper at a level considered potentially dangerous to aquatic organisms.

E092

TRACE METAL DISTRIBUTIONS AMONG THE HUMIC ACID, THE FULVIC ACID, AND PRECIPITABLE FRACTIONS EXTRACTED WITH NAOH FROM SEWAGE SLUDGES,

Holtzclaw, K. H., Keech, D. A., Page, A. L., Sposito, G., and Gange, T. J.

California University,
Riverside,
Department of Soil and Environmental Science.

Journal of Environmental Quality, Vol. 7, No. 1, p 124-127, January-March, 1978. 2 fig, 4 tab, 11 ref.

Trace metal concentrations in the humic acid, fulvic acid, and precipitable fractions of four organic sludge-soil samples were measured in laboratory experiments with atomic absorption spectrophotometry. After extraction with sodium hydroxide, the humic acid, fulvic acid, and precipitable fractions were analyzed for concentrations of aluminum, cadmium, copper, iron, nickel, zinc, phosphorus, and carbon. Precipitation of the trace metals from solution with pH adjustments to 4.5, 6.5, and 8.5 was examined. Precipitation by pH adjustment of the trace metals, phosphorus, and carbon from the solutions suggested that most of the copper and carbon in the sludge samples was contained in the humic acid fraction. The precipitable fraction, a high ash precipitate formed after pH adjustment of impure fulvic acid, contained the highest concentrations of aluminum, iron, zinc, and phosphorus. Cadmium and nickel were associated primarily with the fulvic acid extraction and to a lesser extent, the precipitable fraction.

E093

RESIDUAL TOXICITIES OF SEVERAL DISINFECTANTS IN DOMESTIC WASTEWATER,

Ward, R. W., and DeGraeve, G. M.

Grand Valley State Colleges,
Allendale, Michigan,
Department of Biology.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 49-60, January, 1978. 13 tab, 18 ref.

Effluent from the Grandville, Michigan, waste water treatment plant was used in studies on the toxicities of nondisinfected, chlorinated, dechlorinated, chlorobrominated, and ozonated effluents. Residual Cl2, BrCl, O3, and sulfite were measured in effluents used to fill aquaria which contained fathead minnows (Pimephales promelas) and Daphnia magna; acidity, alkalinity, total ammonia, conductivity, hardness, and pH were also measured. The study revealed that mean total residual chlorine concentrations as low as 0.045 mg/liter and 0.33 mg/liter could have deleterious effects on fathead minnows and Daphnia, respectively. Dechlorination with sulfur dioxide eliminated these adverse effects. The growth of fathead minnows was retarded by mean residual bromine chloride concentrations as low as 0.034 mg/liter. The survival, growth, and reproduction of fathead minnows were not affected by long-term exposure to ozonated effluents having mean residual ozone concentrations of 0.016 mg/liter or less.

E094

SALMONELLA AND BACTERIAL INDICATORS IN OZONATED AND CHLORINE DIOXIDE-DISINFECTED EFFLUENT,

Schiemann, D. A., Brodsky, M. H., and Ciebin, B. W.

Ontario Ministry of Health,
Toronto, Canada.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 158-162, January, 1978. 5 tab, 17 ref.

Studies were conducted to examine the incidence of Salmonella in secondary waste water effluent and to assess various methods for recovery. The relationship of Salmonella isolation to densities of three bacterial indicator groups (total coliforms, fecal coliforms, and fecal streptococci) in effluents disinfected by ozone and chlorine dioxide was also examined. Samples of effluent from a secondary activated sludge waste water treatment plant in Brampton, Ontario, were disinfected under controlled laboratory conditions. Salmonella recovery by a membrane filter and a glass fiber filter were compared; membrane filter and MPN counts were also compared for total and fecal coliforms in effluent disinfected by chlorine and ozone. Recovery rates for Salmonella from undisinfected primary and secondary effluents were 88.9 and 72.5%, respectively. Rates for effluents which had been treated with ozone, chlorine dioxide, and chlorine were 8.0, 12.5, and 0.0%, respectively. For undisinfected secondary effluent, incubation of the tetrathionate broth at 4.5 C with XLD agar and brilliant green sulfa agar was most effective. Higher coliform densities were generally found in ozonated and chlorinated effluents in which Salmonella had been detected.

E095

BIODEGRADATION OF SOME CATIONIC SURFACTANT AGENTS (Biodegradation de quelques agents de surface cationiques),

Baleux, B., and Caumette, P.

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Montpellier, France,
Laboratorie d'Hydrobiologie.

Water Research, Vol. 11, No. 9, p 833-841, 1977. 15 fig, 1 tab, 18 ref.

The biodegradation of 10 cationic surfactants in sewage wastes and river water was studied. Bacterial growth of heterotrophic populations was not inhibited or destroyed by the cationic surfactants, although pathogenic bacteria were affected. A colorimetric technique using sodium alizarine sulfonate was employed to monitor the decrease of active material during surfactant biodegradation. Measurements of biodegradation were obtained with infrared spectroscopy. The ten cationic surfactants studied were: 15 ethoxymethyl distearyl ammonium chloride, hexadecyltrimethylammonium chloride and bromide, dodecylpyridinium iodide, hexadecylpyridinium bromide, laurylpyridinium chloride, diisobutylphenoxyethoxyethyl benzyl dimethylammonium chloride, quaternary alkylimidazolium compound, ethoxylated tertiary alkyl primary amines, and dimethyldistearylammonium chloride. Five of the alkylammonium compounds were found degradable while the other five were not. Three of the nondegradable products were cyclical alkylammonium compounds of benzene and pyridium, while the other two were petroleum derivatives.

E096

LEAK DETECTOR,

Water and Waste Treatment, Vol. 20, No. 11, p 32, November, 1977.

The English company of Fischer and Porter Ltd., Workington, Cumbria, has developed an automatic chlorination system and a device for the detection of chlorine gas leaks in waste water treatment facilities. The Chloralert Chlorine Leak Detector warns of chlorine gas in the surrounding atmosphere with an alarm light and activates external alarms through electrical contacts. The Chlorimatic chlorination system controls chlorine dosages applied to waste effluent and water supplies. The system, which supplies exact proportions of chlorine gas to varying waste water flow rates and qualities, is vacuum operated and solution fed. The Chlorimatic system, used in processes requiring up to 500 lb of chlorine gas/day, consists of a vacuum regulator, a flowmeter, an ejector, and an automatic control valve developed by Fischer and Porter Ltd.

E097
FILTER MEDIA FOR SAMPLING AND MONITORING,

Water and Waste Treatment, Vol. 20, No. 10, p 54, October, 1977.

A review of filter media products, manufactured by Whatman of England for analytical and filtration processes, is presented. A glass microfiber filter that does not contain binders and can be ignited for gravimetric analysis is used in the measurement of total suspended solids in waste water. Industrial waste water in Japan is analyzed with a thick glass microfiber filter that has a high loading capacity. A paper developed by Whatman with an ion-exchange resin coating is used in the detection of metal ions in water. A glass microfiber filter is also used in the gravimetric analysis of ruthenium-106 in sea water. Whatman cotton cellulose thimbles are used in conjunction with a solvent to remove animal or mineral fats, greases, and oils from sludge. Specific resistance of sludge to filtration is measured with Whatman No. 1 filter papers or No. 17 chromatography paper. A glass microfiber filter with a high flow rate and 1.6 micrometer retention is used to identify Salmonella and Pseudomonas aeroginosa in water supplies. Bacteria analysis of potable water is also conducted with No. 17 filter pads. Whatman produces five glass microfiber filter grades and 28 cellulose filter varifies.

E098
TWO COMPLEMENTARY ULTRASONIC SYSTEMS,

Water and Waste Treatment, Vol. 20, No. 10, p 42, 44, October, 1977.

An ultrasonic effluent sampler and monitor, produced by Endress and Hauser, provides pH, dissolved oxygen, water level, and flow data. The water sampling system monitors pH and dissolved oxygen levels; the level monitor utilizes an echo gauge; and the flow metering is performed in open channels by an ultrasonic sensor. PH monitoring for short or long distances is accomplished by a constant meter reference electrode and a glass electrode that galvanically charges the effluent with a voltage dependent the upon ion concentration of the water. Dissolved oxygen levels in the waste water are measured by a gold and silver electrode covered by a plastic membrane pervious only to oxygen. Flow proportional or time proportional water sampling is conducted by a glass cylinder with an air pump and a pinch valve. The level monitoring device is used for the measurement of grit, sump pump, sludge-water interfaces, and digestors. Flow measurements in open channels are accomplished by an ultrasonic gauge that monitors elapsed time of echoes between the surface of the water and the gauge. The measurement is converted into an analog signal proportional to the flow within the open channel.

E099
VERSATILE WASTEWATER FLOWMETER,

Water Services, Vol. 81, No. 981, p 685-686, November, 1977.

The digital QSFM4 waste water flowmeter, developed by Quantum Science Ltd., accurately measures the depth of flow in pipes, channels, or flumes. The digital system employs a series of 20 vertical thermistors, each representing 5% increments in flow. Data obtained by the thermistors on flow increments is transcribed by the digital instrument into gal/hr, gal/day, liters/hr, or liters/day. Total and maximum flows are automatically computed; note is made of the number of times the flow has exceeded a preset flow limit. The digital flowmeter is capable of operating external automatic analyzers or samplers within a preset schedule. The flowmeter can be modified to show rate of loss of a substance, such as calories. Accuracy is maintained by the digital unit to ensure integrated readings.

E100
AUTOMATION OF WASTE WATER TREATMENT PLANTS--PART 1--DATA COLLECTION AND USE,

Cotton, P.

Effluent and Water Treatment Journal, Vol. 17, No. 7, p 331-332, 335, July, 1977.

The collection and storage of data in waste water treatment facilities by automatic computer operation is evaluated. Analog and digital computer data can be displayed at the monitoring site or transmitted to the central control room for processing or display. Printed logs of treatment facility data are processed and provided by central processing units. Analog systems are being replaced by digital and direct digital control systems that are more reliable. Data collected in the treatment facility can be used for automatic control, daily operation in manually-controlled plants, evaluation of plant efficiency, accumulation of a data base for future design reference, and specific data investigations. Physical parameters measured in treatment facilities include: flows and volumes; settled sewage, sludge, and process liquor measurement; and energy usage. Analyses provided by computer control include: dissolved oxygen levels; suspended solids contents; sludge density; and thermal digestor gas values.

E101

A STUDY ON THE LOADING AND PERFORMANCE OF SEWAGE TREATMENT PLANTS,

Stones, T.

Effluent and Water Treatment Journal, Vol. 17, No. 7, p 352-353, July, 1977.
3 tab, 11 ref.

The measurement of oxidizable load on a waste water treatment facility according to BOD and permanganate values was evaluated for the effective calculation of biological filter and activated sludge capacities. BOD and permanganate values provide only partial measurement of total carbonaceous oxygen demand and did not reflect nitrogenous oxygen demand. A comparison of BOD reduction by biological filtration and activated sludge indicated higher reduction rates by the activated sludge treatment. However, the biological filter reduced the nitrogenous oxygen demand by 73%, the dichromate value by 77.8%, and the total oxygen demand by 76.6%. The activated sludge method achieved reductions in nitrogenous oxygen demand of 23.1%, dichromate value of 69.2%, and total oxygen demand of 56.1%, reductions that were significantly lower than with biological filtration. The activated sludge method was considered better for reducing BOD than the filtration technique. For total oxygen demand, a 76% reduction was achieved by biological filtration and a 56.1% reduction by activated sludge. The analysis of total oxygen demand reduction, consisting of carbonaceous and nitrogenous oxygen demand, was considered superior to BOD and permanganate analyses for the calculation of treatment plant loading and performance.

E102

AUTOMATIC MONITORING TECHNIQUES OF EUTHOPHICATION SUBSTANCES IN COASTAL SEA WATER (Sangyo haisui no fueiyokaseibun no shori ni kansuru kenkyu-kenshutauki haihatsu ni kansuru kenkyu),

Hiiro, K., Tanaka, T., Kawahara, A., and Hagiwara, K.

Analytical Chemistry Section,
Government Industrial Research Institute,
Ministry of International Trade and Industry,
Osaka, Japan.

Tsusansho kogyo gijutsuin sangyo kogai kenkyu kaihatsu choseikyoku 51 nendo kogai tokubetsu kenkyu hokoku, No. 47, p 1-6, July, 1977. 4 fig, 3 tab, 8 ref.

A two year eutrophication study of coastal sea water vulnerable to red tide monitored nitrate ion, phosphate ion, and organic substance concentrations. Selective ion sensitive electrodes and absorbence differentials for concentration calculations were developed. Nitrate nitrogen concentrations ranging 1.4-1,400 ppm were detected by two types of electrodes developed for the study. An Urushi matrix membrane in a liquid ion exchanger produced a linear nitrate-nitrogen calibration curve similar to that produced by the polyvinyl chloride membrane in a liquid ion exchanger. Phosphate-phosphorus was monitored by a lead sulfide membrane electrode with a sensitivity range of 0.31-3,100 ppm phosphate-phosphorus at pH 7-9. Correlation coefficients for total nitrate and nitrite ions in sea and river water samples were calculated according to absorbence differences between 223 and 232 mm. The 14 sea water and 18 river water samples yielded correlation coefficients of 0.81 and 0.94, respectively. Absorbence differences between 250 and 280 nm produced a correlation factor of 0.96 to total organic carbon in the sea water samples. Fluorescence was used to measure the organic content of the sea water samples; the correlation coefficient was calculated at 0.96 for the organic and total carbon fluorescence intensities. Ion exchange-precipitation methods for enrichment of nitrate-nitrogen and phosphate-phosphorus were installed; an automatic monitoring station is planned.

E103
COMPUTER CONTROLS PIPELINE FLOW,

Water and Waste Treatment, Vol. 20, No. 12, p 34-35, December, 1977. 1 fig.

The Eindhoven sewage treatment plant in the Netherlands, designed to treat effluent from a maximum potential population of 750,000 and an expanding industry, is controlled by a Philips P800 minicomputer with telemetry links. The computer system also monitors and controls the flow in the 46 km long pipeline through which sewage is transported to the treatment facility. A P855 computer collects and displays data in the central control room on measurements of levels, flows, motor currents, and operating hours. Computer control of the six sewage pumps located between the coarse screens and the grit remover has maximized pump efficiency by operating the pumps in sequential order according to the monitored effluent levels in the three supply channels. The computer operates the sewage transport pipeline as a buffer reservoir by incorporating monitored pipeline data into a simulated model of the line. Flow data relayed to the computer by the telemetry system allows the balance of water levels in the pipeline for optimal buffer capacity, and prevents or controls overflows. Control stations and a pumping station along the pipeline route are also under computer control.

E104
DETERMINATION OF COD USING A SEALED-TUBE METHOD,

Best, D. G., and de Casseres, K. E.

Water Pollution Control, Vol. 77, No. 1, p 138-140, 1978. 7 tab, 3 ref.

A sealed-tube technique using titration or colorimetry for COD analysis of standard and oxidation-resistant compounds was compared to the conventional reflux COD method. A solution contained 10.126 g of potassium dichromate, 167 ml of sulfuric acid, and 33.3 g of mercuric sulfate was mixed in a sealed glass tube with a catalyst solution containing 22 g of silver sulfate and 2.5

liters of sulfuric acid. The mixture was rotated and heated to 150 C in a block thermostat unit. The reaction mixture was then diluted and fed to a colorimeter or a titrator. This tube method was capable of recovering 100.4% of potassium hydrogen phthalate, 99.9% of glucose, and 97.3% of glutamic acid. Ethanol and sodium dodecyl benzene sulfonate, considered difficult to oxidize, were recovered more efficiently with the sealed tube method than with the standard reflux technique. The two analytical procedures were comparable in precision analyses with synthetic potassium hydrogen phthalate standard solutions and waste water samples. When compared to the reflux technique, the sealed tube process required 75% less testing space and saved an estimated 70% of the cost of chemicals for analysis.

E105

AIRBORNE ENTERIC BACTERIA AND VIRUSES FROM SPRAY IRRIGATION WITH WASTEWATER,

Teltsch, B., and Katzenelson, E.

Hebrew University-Hadassah Medical School,
Jerusalem, Israel,
Environmental Health Laboratory.

Applied and Environmental Microbiology, Vol. 35, No. 2, p 290-296, February, 1978. 7 fig, 2 tab, 15 ref.

Aerosolized bacteria and viruses were monitored in an agricultural area spray irrigated with sewage effluents. Marker strains of mutant E. coli, introduced into the irrigation effluent, were present in the air only when the E. coli concentration in the waste water exceeded 1,000/ml. Monitoring of temperature, solar irradiation, relative humidity, and wind velocity was conducted simultaneously with the air sampling. Peak solar irradiation coincided with the minimum relative humidity level and aerosolized bacterial density. Samples obtained at night yielded bacterial concentrations 10 times higher than for corresponding daytime measurements. The correlation coefficient between bacteria and relative humidity was calculated at 0.80; the correlation coefficient with solar irradiation was -0.50. Wind velocity and temperature did not influence bacterial density. Four out of 12 air samples collected at a distance of 40 m downwind from the irrigation site contained echovirus 7. Coliforms were detected in air samples obtained as far as 350 m downwind of the spray irrigation lines.

E106
NOVEL COMBINATION METHOD ASSESSES SEWAGE ODORS,

Molton, P. M., and Cash, D.

Batelle Pacific Northwest Laboratories,
Richland, Washington.

Water and Wastes Engineering, Vol. 15, No. 2, p 47-48, 50, 52, February, 1978.
3 fig, 1 tab.

Odor analysis of municipal sewage and sludge was accomplished by a combined method of organoleptic testing and gas chromatography. Threshold odor numbers were defined for sludge treated by digestion, irradiation, and heat, and untreated sludge in a series of tests by a six member panel. An electron capture detector was employed in the gas chromatography analysis of sewage and sludge odor. Gas chromatography indicated that digestion of sludge significantly reduced the odor of the effluent. The results of the organoleptic and gas chromatography analyses indicated that odors vary with time; peak odor levels were followed by odor decreases. Odor development patterns were useful in predicting maximum odor levels. Chemical treatment of minor odorous compounds was suggested as a possible means of reducing odor significantly.

E107
PROGRAMMING PHOSPHATE TREATMENT SAVES MONEY,

Culver, R. H., and Chaplick, D.

Water and Sewage Works, Vol. 125, No. 3, p 84-87, March, 1978. 2 fig, 3 tab, 1 ref.

An alum treatment schedule based on observed hourly variations in phosphorus concentrations was developed for the Pittsfield, Massachusetts, municipal waste water treatment plant. Random sampling of the effluent for phosphorus concentration data proved to be an inefficient basis upon which to calculate alum requirements. Alum additions of 300 mg/liter prior to screening and grit removal reduced effluent phosphorus to 0.8 mg/liter but produced large volumes of sludge with a solids content of 2%. To avoid anaerobic digester failure, alum doses were reduced to 200 mg/liter, reducing effluent phosphorus to 1.5 mg/liter. Hourly sampling of the influent over a seven day period indicated that peak phosphorus flows occurred from 10 a.m. to 12 midnight. With a 20:1 alum-to-phosphorus ratio for treatment, alum was wasted when additions were made on the basis of daily average phosphorus flow. An individual schedule for each day of the week established adequate alum doses with respect to hourly phosphorus data. Simplification of the schedule to eight daily manual additions of the varying alum doses provided the most effective reduction of phosphorus with the most efficient plant operation.

E108

ORGANOCHLORINATED RESIDUES IN WASTEWATERS BEFORE AND AFTER TREATMENT,

Martin, G. B., and Gosselin, C.

Universite Laval,
Quebec,
Department des Vivres.

Journal of Environmental Sciences and Health, Vol. A13, No. 1, p 1-11, 1978. 2 fig, 3 tab, 8 ref.

The removal efficiency of polychlorinated biphenyls, DDT, and other organochlorine compounds present in municipal waste water was studied at a treatment facility in Valcartier, Quebec, Canada. Samples of waste water were collected at the plant inlet and outlet over a five-day period and over a 24-hr period. All samples were analyzed by gas chromatography with electron capture detectors. The municipal facility provided primary and secondary treatment with chlorination. Daily sampling over the five-day collection period yielded a polychlorinated biphenyl concentration range of 0.50-2.00 ppb at the inlet and 0.02-0.60 ppb at the outlet. DDD ranged from traces to 0.07 ppb at the inlet and 0.03 ppb at the outlet. DDT concentrations were as high as 0.08 ppb at the inlet and 0.02 ppb at the outlet. Mean reductions from the inlet to the outlet of the organochlorine compounds during the 24 hr collection were 0.29-1.38 ppb for polychlorinated biphenyl and 0.03-0.08 ppb for DDD. According to the chromatographs, the higher chlorinated polychlorinated biphenyls were more easily removed during treatment than the lower chlorinated compounds. Concentrations of lower chlorinated compounds were increased by the treatment process. A 75% reduction of polychlorinated biphenyls was achieved by the treatment process; DDD and DDT were also eliminated.

E109

SURVIVAL AND MOVEMENT OF FECAL INDICATOR BACTERIA IN SOIL UNDER CONDITIONS OF SATURATED FLOW,

Hagedorn, C., Hansen, D. T., and Simonson, G. H.

Oregon State University,
Corvallis,
Department of Microbiology.

Journal of Environmental Quality, Vol. 7, No. 1, p 55-59, 1978. 2 fig, 3 tab, 8 ref.

A pollutant tracing study, monitoring movement of septic tank and waste water drainage, evaluated the use of antibiotic-resistant fecal bacteria as bioindicators of groundwater contamination under saturated conditions. Two drainage sites were seeded with antibiotic-resistant mutants of E. coli and S. faecalis. Samples were obtained over 32 days from wells located in eight compass directions at 0, 50, 100, 300, 500, 1500, and 3000 cm from each site pit.

Both E. coli and S. faecalis gravitated to the 300 cm well and, in two samples, to the 500 cm wells, within 24 hrs of site innoculation. Rainfall was responsible for reducing the peak numbers of bacteria in the wells farther from the pit site. Bacteria peaks in the 1500 cm well were associated with the first rainfall period; no bacteria reached the 300 cm wells. Both E. coli and S. faecalis survived throughout the 32-day test period and longer survival was considered probable. The antibiotic-resistant bacterial indicators were adequately differentiated from other fecal bacteria populations in septic tank drainage. Interference with tracing techniques by other non-pollution source bacteria can be eliminated by introducing the proper antibiotic.

E110

COMPARISON BETWEEN ADSORPTION OF POLIOVIRUS AND ROTAVIRUS BY ALUMINUM HYDROXIDE AND ACTIVATED SLUDGE FLOCS,

Farrah, S. R., Goyal, S. M., Gerba, C. P., Conklin, R. H., and Smith, E. M.

Texas University Health Science Center,
Houston,
Department of Virology and Epidemiology.

Applied and Environmental Microbiology, Vol. 35, No. 2, p 360-363, February, 1978. 4 tab, 25 ref.

Aluminum hydroxide and activated sludge floc adsorption of poliovirus and simian rotavirus (SA-11) was studied in laboratory experiments. The simian rotavirus was used in place of human rotavirus which was difficult to isolate and culture. Aluminum hydroxide adsorption reduced the titer of added poliovirus by three logs. A one log reduction in simian rotavirus concentrations was achieved with aluminum hydroxide. Human rotavirus was not significantly adsorbed onto aluminum hydroxide flocs. Activated sludge floc adsorption of the viruses resulted in an 0.7-1.8 log reduction in poliovirus and a 0.5 log reduction in simian rotavirus. The results indicated that poliovirus was more readily adsorbed than rotavirus. An estimated reduction of the viruses by adsorption onto both activated sludge and aluminum hydroxide flocs predicted the predomination of rotavirus after waste water treatment. The use of model viruses such as reovirus to predict the fate of viruses in waste water treatment was considered.

E111

IS INADEQUATE SLUDGE AGE AND DISSOLVED OXYGEN CONTROL PREVENTING OPERATORS FROM GETTING THE BEST FROM THEIR ACTIVATED-SLUDGE PLANTS?,

Pitman, A. R.

Water Pollution Control, Vol. 77, No. 1, p 97-99, 1978. 1 fig.

The optimization of the activated sludge waste water treatment process is considered with respect to sludge age and dissolved oxygen control. Clarifier capacity increases at a constant feed rate of homogenous sludge and a dissolved oxygen level of 2 mg/liter. As sludge age increases under these circumstances, effluent clarity improves due to increased bioflocculation efficiency; the sludge settling rate increases with higher floc density; and the quantity of sludge produced decreases. The oxidation of organic nitrogen and ammonia also improves while the floc oxygen demand and mixed liquor suspended solids increase. As sludge age increases, optimum conditions are approached. These include the reduction of the protozoa population, the presence of bacteria in the endogenous growth phase, the deterioration of bioflocculation, and the continuing increase of floc density, suspended solids, total oxygen demand, and clarifier solids levels. When sludge age exceeds the optimum conditions, deflocculation occurs. Two examples of effluent deflocculation are presented. In one case, control of the dissolved oxygen level below capacity improves the clarified effluent quality. In the second case, reducing sludge age improves the ambient dissolved oxygen level.

E112

CHLORINE DETECTOR SAVES A LIFE,

Public Works, Vol. 109, No. 3, p 77-78, March, 1978.

A Chloralert chlorine detector, installed in a municipal treatment facility in Dover, New Hampshire, was responsible for detecting a potentially fatal chlorine leak. The Chloralert system, developed by the Fischer and Porter Co., continuously samples the air through an intake pipe connected to a suction system. Because chlorine is twice as heavy as air, the chlorine monitor is located at floor level. The Chloralert is capable of detecting chlorine levels to 1 ppm. The monitor system is equipped with an automatically activated flasher and an external bell. Chlorine at the Dover waste water treatment plant is surveyed continuously; the Chloralert monitor is connected by an output terminal to a remote alarm at the police station. Chlorine detectors are required in all new treatment facilities in New Hampshire.

E113
GAS MONITORS FOR SEWAGE TREATMENT WORKS,

Canadian Chemical Processing, Vol. 61, No. 12, p 682, 685, December, 1977.

A gas monitoring device for sewage treatment facilities, developed by Neotronics Ltd, prevents poisoning of the catalytic sensing element by reducing the exposure to heat and using digital calibrations. Catalytic sensing devices for monitoring sludge gases and silicone vapors often fail within a short period of time as a result of heating of the catalyst which oxidizes the gaseous materials. The Neotronics gas monitoring device is equipped with a Pellistor catalytic sensing head which is heated for 10 seconds every 4 min. Gas monitoring data is collected by a digital sensing circuit which compares the information to a digital logic format. In the presence of catalytic poisoning, the sensing circuit registers a zero condition to which the digital logic responds with an alarm. When catalytic poisoning is not present, the calibration stability increases 20 fold with zero or stability drift. The system is equipped with a fail-safe instrument malfunction indicator.

E114
INSTRUMENTATION AND AUTOMATION IN WATER AND WASTEWATER TREATMENT,

Brinkoff, H. C.

Philips Environmental Protection,
Eindhoven, The Netherlands.

Water Pollution Control, Vol. 77, No. 1, p 55, 1978.

The instrumentation of an automated waste water treatment facility in the Netherlands is described. The plant utilizes process stream analyzers, sensors, telemetry, and computers. The combustion of organic matter at 900 C with a catalyst is monitored for total oxygen demand by a meter located near the conditioned gas stream containing the organic wastes. Coulometric titration restores the oxygen from combustion to its original condition. Electrochemical water quality sensors measure pH, conductivity, dissolved oxygen, and redox potential. An ion-sensitive electrode is used to monitor chlorides; additional instruments record temperature and turbidity measurements. An automatic electrode calibration unit compares on-site measurements with levels experienced under laboratory conditions. An ultrasonic transducer automatically unclogs the sensor; the optimum design of the sampling unit and measuring cell also contributes to accuracy. Automation of Amsterdam's potable water treatment plant is in progress. Optimization of the sewage treatment plant during large flows will be achieved when the automation of the main pipelines is completed.

E115
STERIC HINDERANCE ON COMPETITIVE INTERACTION IN ACTIVATED CARBON ADSORPTION FROM BI-SOLUTE SOLUTION OF PHENOL AND ORGANICS IN BIOLOGICAL TREATED SEWAGE,

Tambo, N., and Fukushi, K.

Journal of Japan Water Works Association, No. 518, p 28-40, November, 1977.
23 fig, 8 ref.

Mathematical models were developed for calculating the competitive adsorption onto activated carbon in a bi-solute solution containing phenol and organic materials in biologically treated waste water. The mathematical models, adapted from Langmuir's bi-solute adsorption equations, incorporated the effects of spatial limitations on the adsorption of phenol caused by sewage molecules occupying available sites. The equations accurately predicted the deterioration of the adsorbed phenol equilibrium in response to competition with organic materials for activated carbon adsorption. A method for calculating the equilibrium deterioration rate was also developed using the comparative molecular size of the bi-solute molecules. Experiments were conducted to verify the accuracy of the deterioration rate predictions.

E116
CONCEPTS, CRITERIA, AND MEASUREMENTS OF BIODEGRADABILITY,

Bunch, R. L.

Wastewater Research Division,
Municipal Environmental Research Laboratory,
United States Environmental Protection Agency,
Cincinnati, Ohio.

In: Polish/U.S. Symposium on Wastewater Treatment and Sludge Disposal: Volume II, February 10-12, 1976. 1976, p 132-140. Technical Report EPA-600/9-76-021.

Biodegradation criteria and analyses of waste water compounds that pose a potential threat to the environment are reviewed. Polluting compounds in the waste water must first be identified; the extent of degradation required to obviate their effects should be determined. Future criteria for the degradation of polluting compounds to cell matter, carbon dioxide, and water are recommended to reduce the input of harmful substances to potable and surface waters. Methods of calculating the biodegradability of waste water-borne compounds are reviewed. These include: river die-away or natural microbial degradation in rivers; Warburg respirometry to measure oxygen demand of microorganisms; BOD tests for dissolved oxygen uptake; flask tests with a chemically defined medium and preadapted seed; and the activated sludge method in continuous or semicontinuous flows. Laws mandating the use of biodegradable materials and further research in biodegradation byproducts, rates, and extents are recommended.

E117
SAMPLING OF WATER AND WASTEWATER,

Shelley, P. E.

EC and G Washington Analytical Services Center, Incorporated,
Rockville, Maryland.

1977. 320 p, 7 fig, 11 tab, 21 ref, 1 append. Technical Report EPA-600/4-77-039.

Water quality monitoring techniques, practices, and equipment designs are reviewed for waste water and water sampling procedures. Sample types are classified and recommendations for handling, preservation, and quality are made. Information on site selection, sampling frequency, and source flows is presented. Situations in which manual or automatic samplers are preferred are identified; sampler intake, gathering, transport, and storage designs are evaluated. Automatic sampling equipment is reviewed, including commercially-marketed and custom-designed equipment. Field sampling procedures are recommended with respect to automatic and manual sampling techniques and equipment maintenance. A thorough evaluation of 266 automatic sampling devices and custom designed units is included.

E118
PH AVERAGING,

Eralp, A. E., and Tomson, M. B.

New York State University,
Buffalo,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 389-392, February, 1978. 1 fig, 2 tab, 7 ref.

Numerical pH averaging procedures were evaluated with mathematical models considering pH as an intensity factor and as a capacity factor. PH is illustrated as an intensity factor in protonated and unprotonated systems. A system can display various pH values during proton additions and removals, making it possible for pH values to be registered as acidic for part of the recorded time and basic for the remainder. Simple numerical averaging of pH measurements may yield erroneous data if the average numerical value is assumed to be representative of the series of continuous measurements. This becomes especially significant when the average pH value is used to monitor a waste treatment process, such as nitrogen stripping, which is only operable within a specific pH range. Numerical averaging when pH is an intensity factor is valid only when standard deviations and other parameters are considered. Numerical averaging of pH as a capacity factor is suitable for elements which exhibit conservative behavior, such as divalent calcium and sodium.

E119

EFFECT OF THERMAL PRETREATMENT ON DIGESTIBILITY AND DEWATERABILITY OF ORGANIC SLUDGES,

Haug, R. T., Stuckey, D. C., Gossett, J. M., and McCarty, P. L.

LA/OMA Project,
Whittier, California.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 73-85, January, 1978. 6 fig, 4 tab, 11 ref.

Thermal pretreatment of organic sludges increased the biodegradability and improved the methane gas production of activated sludge. Digested, primary, flotation-thickened, and activated sludges were treated at 175 C for 30 min in laboratory pressure reactors followed by anaerobic digesters. Thermal pretreatment of activated sludge increased the methane production by 60% and decreased volatile suspended solids by 36%. In primary sludge, volatile suspended solids and COD were reduced by more than 60% but gas generation did not significantly increase. Methane gas production increased by 14% after thermal pretreatment of a mixture of primary and activated sludge; volatile suspended solids levels decreased by 16%. Thermal pretreatment of waste activated sludge at temperatures up to 175 C improved the biodegradability and gas production of the sludge. Treatment at 200 C and 225 C of basic activated sludge adversely affected the sludge properties and gas generation. After thermal pretreatment, residual heat in the sludge was sufficient for digestion without supplementary fuel being required. Odors were reduced during anaerobic digestion after thermal pretreatment.

E120

THE BACKGROUND TO, AND THE APPLICATION OF, LABORATORY INSTRUMENTATION TO WATER ANALYSIS,

Cottrell, C. T.

AC/UV Applications Laboratories,
Pye Unicam Limited,
Cambridge, England,

Water Services, Vol. 81, No. 981, p 663-668, November, 1977. 5 fig, 1 tab, 21 ref.

Analytical techniques to measure pollutants in water are described, including: gas-liquid chromatography, atomic absorption spectrophotometry, ultraviolet and visible spectrophotometry, automatic chemistry systems, and infrared spectroscopy. Chlorinated and organophosphorus pesticides, petroluem hydrocarbons, phenols, organo mercury compounds, and fatty acids are identified with gas-liquid chromatography in conjunction with thermal conductivity, flame ionization, electron capture, flame photometric, and alkali flame ionization detectors. Atomic absorption spectrophotometers of the single- or double-beam variety are employed to detect 66 metallic elements contained in waste water. Single- and double-beam ultraviolet and visible spectrophotometers measure non-metallic inorganics, nutrients, detergents, organic compounds, color, and turbidity. Spectrophotometrically visible substances, such as ammonia, chloride, silicate, nitrate, nitrite, and phosphate, are analyzed by automatic chemistry systems. Double-beam infrared spectroscopy is used to identify organic compounds, in industrial wastes, detergents, chlorinated pesticides, carbohydrates, and amino acids.

E121

VORTEX-SHEDDING FLOWMETERS,

Water Services, Vol. 82, No. 986, p 241-242, April, 1978. 3 fig, 1 tab.

Neptune International Corporation has developed a vortex-shedding flowmeter, the Vort-X-Cel, which supplies a digital flow rate output. The system contains a sensor whose pulses are converted into flow rate measurements by two signal processing modules. Power is supplied by modules with input ranges of 24-35 Vdc, 111 Vac, or 220 Vac. The flow rate read-out can be provided by an optional scaling circuit module in engineering measurements, such as gal, barrels, or cu ft; analog output is also an available option. For accurate measurement, the flow transmitter should be installed in an unobstructed pipe without protruding gaskets or weld beads upstream. Pressure taps may be installed at a distance four pipe diameters upstream from the transmitter; temperature taps should be no more than two pipe diameters downstream. The Vort-X-Cel flowmeter is applicable to liquid and gas streams.

E122

VIRION AGGREGATION AND DISINFECTION OF WATER VIRUSES BY BROMINE,

Sharp, D. G.

North Carolina University,
School of Medicine,
Chapel Hill,
Department of Bacteriology,

1976. 43 p, 14 fig, 19 ref. Technical Report EPA-600/2-76-163.

Bromine disinfection of viruses was evaluated with aqueous solutions containing single particle or aggregated suspensions of poliovirus and reovirus. Quantitative analysis of single particle reovirus and poliovirus was performed by electron microscopy. Disinfection of the single particles by bromine required the development of a special apparatus to accommodate the exposure times, 0.05 sec in some cases, required for virus inactivation. First order reactions of both viruses with bromine were observed and equated as linear, semi-log graphs. Poliovirus inactivation occurred at a rate of 6 log units/min; reovirus infectivity declined at a rate of 3 log units/min. Single polio virus disinfection with 10 micromoles of bromine was twice as rapid at 10 C than at 2 C and more rapid at 20 C than at 10 C. Single reovirus was inactivated 30 times faster than poliovirus. Aggregated viruses had a significant effect on the disinfection kinetics of bromine. Slightly aggregated reovirus displayed a continuous reaction rate decline that deviated from the first order reaction. Other experiments with aggregated reovirus disinfection by bromine demonstrated that single reovirus was 200 times more sensitive to bromine treatment than aggregated reovirus, which survived for up to four minutes with the same bromine dose that inactivated single reovirus within 1-1/3 sec.

E123
A PASSIVE FLOW MEASUREMENT SYSTEM FOR STORM AND COMBINED SEWERS,

Foremand, K. M.

Grumnan Aerospace Corporation,
Bethpage, New York.

1976. 135 p, 71 fig, 2 tab, 6 ref, 1 append. Technical Report EPA-600/2-76-115.

A nonintrusive flow measurement technique using an acoustic emission flowmeter was evaluated for application to combined and storm sewers. The method was designed for conduits and channels with varying geometric cross-sections and discontinuities. Fluid flow rates through conduits were calculated and measured with the flowmeter in laboratory and field tests. Flows were analyzed with the aid of a dipolar pseudosound which was emitted from the flow in a perpendicular direction. This acoustic emission was the result of the reaction of the fluid with a solid surface within the area of the conduit discontinuity. The pseudosound emitted was recorded by an accelerometer. The acoustic emission flowmeter technique was applied to open channel, full flow, and pressurized flow conditions, establishing steady, unsteady, uniform, and nonuniform flows in waste water conduits. Field evaluations of the metering technique supported the laboratory findings.

E124
WATER/WASTEWATER SURVEY GUIDELINES,

Schanche, G. W., Greep, L. A., Cannon, J. R., and
Donahue, B. A.

Construction Engineering Research Laboratory,
Champaign, Illinois.

1976. 55 p, 11 fig, 12 tab, 1 append. NTIS Technical Report AD/A-033-233.

A survey format provides guidelines for improving data collection and analysis techniques in the design, planning, and installation of water and waste water treatment facilities. The guidelines are constructed to assist in the preparation and performance of water and waste water surveys by supplying a format for collecting specific background data. Conceptual guidelines are offered for conducting waste water mass balances, designing sampling schedules, and measuring waste water flows. Survey designs for water law compliance, waste source identification, and ambient water quality evaluation are presented. Information from these surveys is employed in evaluating environmental impact, characterizing design problems, and analyzing designs. Background information on sampling sites, waste water sources, and flow measurement techniques is provided.

E125
MEDICALLY USED RADIONUCLIDES IN SEWAGE SLUDGE,

Erlandsson, B., and Mattsson, S.

University of Lund and Lund Institute of Technology,
Lund, Sweden,
Department of Nuclear Physics.

Water, Air, and Soil Pollution, Vol. 9, No. 2, p 199-206, 1978. 3 fig, 2 tab, 6 ref.

Sewage sludge from the municipal waste water treatment plant in Malmo, Sweden, was analyzed for concentrations of radionuclides using a Ge(Li)-spectrometer. The radionuclides had been discharged by one of the town's hospitals which used the radioisotopes for medical procedures. The plant treated wastes from a population of 225,000 using partial biological treatment and sludge digestion, producing 1,320 cu m of digested sludge monthly with a solids content of 23%. The concentration of iodine-131, which is orally administered to and subsequently excreted by patients at the hospital, ranged from 0.03-0.12 nanocuries/kg, assuming a sewage-to-sludge iodine-131 concentration ratio of 6:1. Concentrations of gold-198 were 0.030-0.069 nanocuries/kg in two samples but were below detection limits in the remainder. Gamma ray emissions by other radionuclides interfered with analyses for strontium-85 which was discharged to the treatment plant at a rate of about 0.2 microcuries/week.

E126
THE BEHAVIOR OF F2 COLIPHAGE IN ACTIVATED SLUDGE TREATMENT,

Balluz, S. A., Butler, M., and Jones, H. H.

Cambridge Journal of Hygiene, Vol. 80, No. 2, p 237-242, 1978. 1 fig, 1 tab, 12 ref.

Influent, effluent, and mixed liquor from a model activated sludge plant were innoculated with f2 coliphage and monitored for 5 days. Titers of the bacteriophage increased rapidly in the mixed liquor and the effluent, reaching a plateau after about 20 hrs. Titers of the virus from the liquid and solid portions of the mixed liquor before innoculation indicated that a higher percentage of the bacteriophage was contained in the solids fraction. After innoculation, 84% of the total titer was contained in the liquid fraction. After innoculation ceased, the solids portion had the higher 64% virus content. The f2 coliphage concentration in the effluent during innoculation was about 20.4% of that in the influent, indicating 79.6% removal by the model activated sludge plant. When the influent settled sewage was replaced with raw sewage, plant efficiency dropped to 26.3% during innoculation. A comparison of the titers of f2 coliphage with data from a previous study using poliovirus showed that poliovirus was concentrated in the solids portion of the mixed liquor during innoculation; the removal rate of the poliovirus by the model plant was 99.96%. The f2 coliphage was not considered an appropriate model for studies of human enteroviruses.

E127

MEASURING PETROLEUM HYDROCARBONS IN DIGESTED SEWAGE SLUDGES,

Liu, D. L.

Process Research Division,
Canada Centre for Inland Waters,
Environment Canada,
Burlington, Ontario.

Water and Sewage Works, Vol. 125, No. 3, p 40-44, March, 1978. 11 fig, 2 tab, 13 ref.

Lipids and petroleum hydrocarbons contained in anaerobically digested sewage were measured in samples from three Canadian municipal sewage treatment plants by infrared, gas chromatography, mass spectrum, and microbiological assay techniques. Land application of digested alum sewage sludge from the Point Edwards treatment plant in Ontario inhibited the growth of orchardgrass. A comparison of the composition of this sludge with iron sludge from North Toronto and lime sludge from Newmarket yielded no significant differences. The Point Edwards sludge contained a lipids concentration of 23% by sludge dry weight. Total lipid concentrations in the anaerobically digested chemical sewage sludges were: 10,403 mg/liter in the alum sludge, 636 mg/liter in the iron sludge, and 733 mg/liter in the lime sludge. Petroleum hydrocarbon concentrations in the sludge were 7,580 mg/liter for the alum sludge, 524 mg/liter in the iron sludge, and 434 mg/liter in the lime sludge. Gas chromatography revealed that a higher percentage of the petroleum hydrocarbons in the sludges were fractions of the high molecular weight n-paraffin, indicating that motor oil and grease were components of the petroleum hydrocarbons. Three saturated fatty acids, myristic, palmitic, and stearic acids, were found in the alum sludge as products of hydrocarbon oxidation.

E128

CONCENTRATION OF ENTEROVIRUSES FROM LARGE VOLUMES OF TAP WATER, TREATED SEWAGE, AND SEAWATER,

Gerba, C. P., Farrah, S. R., Goyal, S. M., Wallis, C., and Melnick, J. L.

Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Applied and Environmental Microbiology, Vol. 35, No. 3, p 540-548, March, 1978. 3 fig, 4 tab, 31 ref.

Fiberglass depth cartridges in series with pleated epoxy-fiberglass filters were evaluated as adsorption media for the concentration of enteroviruses from treated waste water, tap water, and sea water. The filter adsorption-elution method of virus recovery was tested with 10 inch filters having capacities up to 10 gal/min. The sample water containing the virus was acidified to pH 3.5 and mixed with aluminum chloride. After adsorption on the filters, the virus was eluted with one to five filter washings with 1,600 ml of glycine adjusted to pH 10.5. The viral eluates were neutralized before reconcentration with aluminum flocculation and hydroextraction. The virus recovery rates were: 52% from tap water, 53% from sea water, and 50% from secondary treated sewage. Nearly all the virus was extracted from sewage solids in tests with virus adsorbed on activated sludge. In further tests, the laboratory batch procedure recovered a maximum of 80% of the virus, compared to 82% for an in-line acid-salt injection method.

E129

NEW PROCEDURE DETERMINES AEROBIC SLUDGE STABILITY,

Hartman, R. B., Bennet, E. R., Linstedt, K. D., and Smith, D. G.

Virginia University,
Charlottesville,
Department of Civil Engineering.

Water and Sewage Works, Vol. 125, No. 4, p 42-44, April, 1978. 2 fig, 16 ref.

The stability of aerobically digested sludge was measured by a modified lead acetate strip procedure which provided a stability index from hydrogen sulfide production by Desulfovibrio bacteria. Conventional means of stability determination by total and volatile solids reduction were considered inadequate because of the influence of sludge composition and age. The specific oxygen uptake rate method of stability calculation was rejected because of its dependence upon digestion reactor environment, temperature, and sludge age. The lead acetate strip test was modified from a method introduced by Ruffer. A 10 ml sample of digested sludge was placed in a 6-inch test tube containing a strip of lead acetate paper. The tube was stoppered and incubated at 37 C until the test paper turned brown or black, indicating hydrogen sulfide generation. The stability index was defined as the duration of the incubation period. The procedure was applicable to both drained and undrained sludge samples. The method provided closer contact of the lead acetate strip with hydrogen sulfide, a more favorable temperature for Desulfovibrio bacteria, and a minimum sample size requirement.

E130

PROTON BINDING IN FULVIC ACID EXTRACTED FROM SEWAGE SLUDGE-SOIL MIXTURE,

Sposito, G., Holtzclaw, K. M., and Keech, D. A.

California University,
Riverside,
Department of Soil and Environmental Science.

Soil Science Society of America Journal, Vol. 41, No. 6, p 1119-1125, 1977. 2 fig, 3 tab, 15 ref.

Proton disassociation from sludge-derived fulvic acids was measured with potentiometric titrations conducted at 25 C and pH 11 using potassium-fulvate solutions in a potassium ionic medium and hydrochloric acid. Using a model describing the titration curve of fulvic acid, formation functions and conditional protonation constants were calculated for the classes of acidic functional groups protonating between pH 3-11. Three functional groups of weak acids were evaluated for logarithmic protonation constants averaging 3.9, 6.5, and 9.4. The quantity of titratable protons within the functional groups decreased with increasing standing time between preparation of the fulvic acid solution and calculation of the titrametric curve. Data on the reversibility of the fulvic acid titrations was also collected.

E131

ANIMAL DISEASE HAZARDS OF SLUDGE DISPOSAL TO LAND: OCCURRENCE OF PATHOGENIC ORGANISMS,

Argent, V. A., Bell, J. C., and Emslie-Smith, M.

Northumbrian Water Authority,
Newcastle upon Tyne, England.

Water Pollution Control, Vol. 76, p 511-516, 1977. 5 tab, 31 ref.

Laboratory studies investigated the presence of worm eggs, salmonella, and Mycobacterium tuberculosis in raw, primary digested, and secondary digested sludge which was to be applied to land. The raw sludge was anaerobically digested at about 32 C for 37 days. The sludge underwent secondary digestion for 33 days before it was applied to land. Sludge samples were obtained at each point in sludge processing. No trematode, nematode, or cestode ova were detected in 20 raw sludge samples, 33 primary digested sludge samples, or 33 secondary digested sludge samples. Raw sludge obtained from 28 small treatment plants did not contain worm eggs. Mycobacterium tuberculosis was undetected in 10 digested sludge samples, although non-pathogenic Mycobacterium terrae was identified. Out of 33 samples of secondary digested sludge to be applied to land, 22 samples were positive for salmonella with 9 serotypes identified. Four serotypes of salmonella were detected in 6 of 9 raw sludge samples and 12 out of 13 mixed samples contained 13 serotypes. Samples of raw sludge from the 28 small treatment plants showed 9 instances of salmonella as evidenced by 7 serotypes. The quantity of salmonella in raw sludge was less than 105/100 cu cm; the number of salmonella found in digested sludge ranged from 10-161/100 cu cm.

E132
SOIL PERCOLATION TESTS IN THE LAGOS AREA,

Aluko, T. M.

Public Health Engineer, Vol. 5, No. 6, p 152-155, 1977. 4 fig, 3 tab, 11 ref.

An empirical formula relating percolation rates with permitted rates of sewage effluent application was applied to percolation test results from six soil sites in Lagos, Nigeria. The sandy-laterite test sites had percolation rates which varied significantly over the three days of testing. Considerable rate differences were recorded for tests sites that were 1 m apart. The allowable sewage loading rates for the six sites as calculated by the empirical formula were less than the standard loading rates defined by Nigerian building codes. Results of the empirical formula would indicate that loading rates on soakaway pits used for domestic waste disposal were excessive. It was concluded that the empirical formula developed for calculating allowable sewage application rates was not valid for Nigerian soil types and therefore, not a universally applicable formula.

E133
A MECHANISM FOR ASH ASSISTED SLUDGE DEWATERING,

Micale, F. J.

Lehigh University,
Bethlehem, Pennsylvania,
Center for Surface and Coatings Research, Sinclair Laboratory.

1976. 51 p, 39 fig, 2 tab, 9 ref. Technical Report EPA-600/2-76-297.

Fly ash and three types of ash from sludge incineration were evaluated as flocculants for improving activated sludge settleability. The ashes, with surface areas from 1.7-17 sq m/g, were washed to separate them into: a solid fraction containing two carbons, two silicas, and magnetite; and a liquid fraction of water soluble salts containing calcium fluoride, aluminum chloride, potassium phosphate, and anionic and cationic polymeric surfactants. Separate experiments were used to test the settling capabilities of the solids and the water soluble salts. Of the solids tested, the carbon black Elf-4 and the silica Quso H-40 were the most efficient flocculants because of their hydrophilic characteristics and high levels of polar groups. Flocculation of the alkaline activated sludge was enhanced by the polar surfaces which adsorbed the cationic and polar molecules and disrupted the sludge particle/liquid interfaces. In the water soluble salt tests, calcium fluoride and aluminum chloride promoted activated sludge settlement via preferential adsorption of the calcium and aluminum ions. Experiments using the unwashed ashes demonstrated that the ash with the most hydrophilic surface and the highest surface area had the greatest effect on activated sludge settleability. The reverse was true for this ash after washing.

E134

AMMONIA VOLATILIZATION FROM SEWAGE SLUDGE APPLIED IN THE FIELD,

Beauchamp, E. G., Kidd, G. E., and Thurtell, G.

Guelph University,
Ontario, Canada,
Department of Land Resources Science.

Journal of Environmental Quality, Vol. 7, No. 1, p 141-146, January-March, 1978. 4 fig, 4 tab, 10 ref.

The volatilization of ammonia-nitrogen from sewage sludge applied over a circular 0.405-hectare area was measured. The sewage sludge was applied at rates of 116,480 and 134,400 kg/hectare; ammonia flux was measured over periods of 5 and 7 days, respectively. Aerodynamic data was obtained at heights of 10, 50, 100, and 150 cm above the sewage application area. The sewage sludge applications monitored over the 5 day period contained 150 kg/hectare ammonia-nitrogen while the 7 day measurement period recorded volatilization of sewage sludge bearing 89 kg/hectare. Ammonia-nitrogen flux measurements were calculated according to the quantity of ammonia molecules carried through a vertical zone by horizontal air movement. Ammonia flux peaked daily around noon, decreasing exponentially with time. Ammonia volatilization was estimated during the 5 day measurement period at 60% or 90.9 kg of ammonia lost/hectare. In the 7 day experiment, 56% or 50.3 kg/hectare of the ammonia was volatilized. Air temperature within two or three days of application was found to affect the rate of ammonia flux. Actual ammonia-nitrogen levels in the sludge and soil layers varied significantly from predictions.

E135

A UNIFIED THEORY OF FILAMENTOUS ACTIVATED SLUDGE BULKING,

Sezgin, M., Jenkins, D., and Parker, D. S.

California University,
Berkeley,
Division of Hydraulic and Sanitary Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 362-381, February, 1978. 16 fig, 3 tab, 36 ref.

The formation of filamentous microorganisms is examined as a factor in bulking during the activated sludge process. The outgrowth of filamentous microorganisms from activated sludge floc is greater than zoogleal microorganism growth under particular conditions within the floc interior conducive to filament growth. Lower floc interior dissolved oxygen levels, from 1.3-1.8 mg/liter in an air system, are more conducive to filament growth than higher dissolved oxygen levels of 6.7-8.0 mg/liter. A minimum sludge floc interior dissolved oxygen level of 2.0 mg/liter, maintained automatically, is considered optimum for sludge settleability. Filaments longer than 10,000,000 microns/ml can increase reflocculation time, 60-min compact volume, and the sludge volume index. A filament length of 10,000,000 microns/ml is considered the dividing point between a bulking and a non-bulking sludge. Activated sludge bulking was reportedly controlled by toxic chemicals, such as chlorine and hydrogen peroxide. Waste character and strength, reactor design, aeration system, and temperature affect the critical dissolved oxygen concentration which limits sludge bulking.

E136

TESTSETS FOR THE QUANTITATIVE ANALYSIS OF AQUEOUS SOLUTIONS WITH PERMANENT INDICATION (Testsets fur die quantitative Analyse waessriger Loesungen mit bleibender Anzeige),

Gleisberg, J.

Zeitschrift fuer Wasser -und Abwasserforschung, Vol. 11, No. 1, p 13-27, 1978. 15 fig, 23 tab, 3 ref.

The Aquanal test sets can quantify trace concentrations of various elements in aqueous solutions by colorimetric techniques. The single-use test kit, equipped with a sampling mechanism and a filter, mixes the sample solution with reagents to form colored cylindrical layers with lengths from 0.5-25 mm which are proportional to the solution concentration as measured on a gauged scale. Aquanal test sets can be used to detect cyanide, iron (III), cobalt (II), copper (II), nickel (II), sulfide, titanium (IV), vanadium (V), and zinc in concentrations of 0.5-10 mg/liter; test sets are available for detecting concentrations over a range of 5-100 mg/liter of cyanide, iron (III), cobalt (II), copper (II), nickel (II), and zinc. Salts can be measured over 50-3,000 mg/liter and 1,000-40,000 mg/liter as sodium chloride. The Aquanal test sets can provide cumulative concentrations, as well as the individual concentrations of elements in solution. Permissible levels of cations and anions in solution which may interfere with analyses are listed for each element. A series of control sets is available for calibration. The system is capable of documenting concentration changes over a certain time period and accumulating trace metals within a small volume of adsorbent.

E137

STUDIES ON THE TREATMENT OF NIGHT SOIL. VII. IDENTIFICATION OF BACTERIA ISOLATED FROM AEROBIC TREATMENT PLANT OF UN-DILUTED NIGHT SOIL AND AMINO ACID UTILIZATION BY THESE BACTERIA (Shinyoshori ni kansuru kenkyu (dainanaho)--mukishaku shinyo no kokusei shorishisetsu karano jokasaikin no burni ro sono amino san bunkaino),

Ishikawa, T., Fukuyama, J., Ose, Y., and Sato, T.

Gifu College of Pharmacy,
Japan,
Department of Environmental Hygiene.

Gifu Yakkadaigaku Kiyo, Vol. 26, p 8-12, 1978. 1 fig, 2 tab, 12 ref.

Amino acid utilization by bacteria isolated from undiluted domestic wastes was identified in aerobically-treated waste water. The domestic wastes were aerated in a series of four digestion tanks following grinding. The wastes were settled; excess sludge was removed; and the waste was diluted. Secondary aeration of the effluent was followed by final clarification and chlorination. Excess sludge from the sedimentation tank, secondary aeration tank, and clarifier was dewatered by centrifugation. Analyses of the treated effluent revealed the presence of Bacillus megaterium, Escherichia coli variety communior, and Staphylococcus epidermis. Oxidation of the amino acid, L-alanine, amounted to 75.2% by B. megaterium and 64.7% by E. coli variety communior. Other forms of amino acid utilization included: L-valine and L-leucine by B. megaterium; L-lysine HCl by E. coli; and L-aspartic acid and L-glutamic acid by E. coli and B. megaterium. The sulfur-bearing amino acids, L-methione and L-cystine, were not appreciably utilized by any of the bacteria isolated.

E138

A RAPID CENTRIFUGE METHOD FOR DETERMINATION AND CONTROL OF SLUDGE CONCENTRATION IN ACTIVATED SLUDGE PLANTS,

Drews, R. J. L. C.

National Institute for Water Research,
Council for Scientific and Industrial Research,
Pretoria, South Africa.

Water SA, Vol. 4, No. 1, p 1-3, January, 1978. 2 fig, 1 tab, 3 ref.

A centrifuge technique to measure mixed liquor suspended solids in activated sludge processes was developed as a more rapid alternative to the half-hour sludge settled volume test currently used by small treatment plants. Two graduated centrifuge tubes were filled with 15 ml of mixed liquor and centrifuged at 2,000 rpm for 2 min. Sludge levels were recorded immediately upon completion of centrifugation; values were multiplied by a centrifuge sludge volume factor calculated from the various solids retention times. A comparison of sludge concentration values obtained from 29 South African plant sludges by half-hour sludge settled volume tests and by the centrifuge method using 4,200 as the sludge volume verified that the centrifuge values were more reliable than the half-hour settling results and more easily obtained than gravimetric data. The half-hour test was still required to provide the sludge volume index for predicting sludge bulking potential.

E139

CRITICAL CONSIDERATIONS ON THE DETERMINATION OF EXTRACTABLE SUBSTANCES IN POLLUTED WATERS (Considerazioni critiche sulla determinazione di sostanze estraibili in acque inquinate),

Legittimo, P. C., Piccardi, E. B., and Pantani, F.

Florence University,
Florence, Italy,
Institute of Analytical Chemistry.

Rassegna Chimica, Vol. 29, No. 6, p 297-303, November-December, 1977. 4 fig, 7 ref.

Methods to extract, identify, and measure fatty substances in large volumes of waste water are examined in detail. Solvent extraction of fatty substances with chloroform is not satisfactory in the presence of nonionic surfactants because of the nearly complete coextraction. Benzene extracts only 20-25% of these surfactants and partially removes anionic surfactants and phenolics. A carbon adsorption method using chloroform for elution results in the nearly complete separation of nonionic surfactants along with fatty substances; anionic surfactants are eluted from the carbon only partially by chloroform. In the presence of phenolics, the chloroform eluate obtained after carbon adsorption must be analyzed spectrophotometrically; the distilled portion is discarded.

E140
THE EFFECT OF QUICK FREEZING ON THE CONTENT OF ORGANIC WATER CAPACITY SUBSTANCES (Die Wirkung des Tiefgefrierens auf den Gehalt an organischen Wasserinhaltstoffen),

Neis, U.

Zeitschrift fuer Wasser -und Abwasserforschung, Vol. 11, No. 1, p 3-7, 1978. 6 fig, 3 tab, 10 ref.

The impact on waste water samples of quick freezing as a storage method was evaluated with respect to values of COD, BOD, and total organic carbon (TOC). Unfiltered samples of waste water from a preclarifier, an activated sludge tank, and a receiving stream were used in the study. One liter samples were quick frozen at -30 C and retained for 8 and 16 days. BOD concentrations in the waste water samples which had been frozen for 8 and 16 days were noticeably lower 5 days after thawing than the concentration of an unfrozen sample. Of the samples which were frozen, the activated sludge effluent had the highest BOD concentration while the receiving stream sample exhibited the lowest values. COD concentrations in preclarified effluent decreased from the initial 137 g/cu m to a minimum of 112 g/cu m after 16 days of freezing; activated sludge liquor COD increased from 2,000 g/cu m to a maximum of 2,520 g/cu m after 8 days of freezing; and receiving water COD increased from an initial 17 g/cu m to 23 g/cu m after 16 days. The TOC values of preclarification effluent and the activated sludge liquor were not significantly affected by freezing.

E141
PROFILE-ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SEWAGE SLUDGE BY GAS CHROMATOGRAPHY (Gas-chromatographische Profilanalyse der polycyclishen aromatischen Kohlenwasserstoffe in Klarschlammproben),

Grimmer, G., Boehnke, H., and Borwitzky, H.

Biochemisches Institut fuer Unweltearcinogene,
Ahrensburg, West Germany.

Fresenius Zeitschrift fuer Analytische Chemie, Vol. 289, No. 2, p 91-95, 1978. 2 fig, 1 tab, 6 ref.

A profile analysis of polycyclic aromatic hydrocarbons in sewage sludge was performed with gas chromatography. A 25 ml source of cyclohexane was mixed with 45 ml of dimethylformamide and 5 ml of water; chromatography was performed with 10 mg of Sephadex LH20 in 50 ml of isopropanol; the cyclohexane was filtered on aluminum oxide. The polycyclic aromatic hydrocarbons were separated by gas chromatography with high performance columns and the signals were compared with internal standards. Five analyses of the sample for 18 main components yielded a variation coefficient of 1.6-11.3%. The retention time of the polycyclic aromatic hydrocarbons controlled the detection limit under amplification. The polycyclic aromatic hydrocarbons were detected in the range of 0.5-5.0 ng while benzo(a)pyrene was in the 1 ng range. Mass spectrometry in conjunction with the gas chromatography was considered unnecessary as the profiles of different sludges were similar.

E142

PHOSPHATE FERTILIZING EFFECT OF SLUDGE FROM DOMESTIC SEWAGE PURIFICATION WITH PHOSPHATE PRECIPITATION (Zur Phosphatduengewirkung von Schlaemmen aus der kommunalen Abwasserreinigung mit Phosphatfaellung),

Gleisberg, D., and Taubel, N.

Hoechst Aktiengesellschaft,
Huerth-Knapsack, West Germany.

Wasser und Boden, Vol. 30, No. 1, p 5-8, 1978. 3 fig, 6 tab, 8 ref.

The phosphate fertilizer value of sludge from municipal waste water treatment plants using alum and iron sulfates for phosphate precipitation was measured in greenhouse and field studies with lettuce, spinach, and corn plants. The phosphate content of the sludge was 18.8-28.5%, compared to 9.4% for untreated sewage sludge and 28.5% for calcined phosphate. For sludge obtained after phosphate precipitation, 12.3-20.5% of the phosphate was soluble in citric acid, 12.5-26.7% in citrate, and 0.1-0.39% in water. There were no significant differences in terms of trace element content between the untreated sludge and that obtained after phosphate precipitation. Greenhouse studies revealed the advantages in terms of fertilizer value of using sludge from phosphate precipitation instead of untreated sludge to amend lettuce and spinach crops grown in acidic and neutral soils. The effect of the sludge was comparable to that of calcined phosphate. Neither the phosphate precipitation sludge or the calcined phosphate enhanced plant growth in a loamy sand at pH 3.8. Field tests with corn demonstrated that soil amendments with phosphate precipitation sludge would not significantly affect the trace element content of the corncobs.

E143
PERSISTENCE OF ENTEROVIRUSES IN SEWAGE SLUDGE,

Subrahmanyan, T. P.

Enteric Viruses Laboratory, Laboratory Services Branch,
Ontario Ministry of Health,
Toronto, Canada.

Bulletin of the World Health Organization, Vol. 55, No. 4, p 431-434, 1977. 1 fig, 2 tab, 14 ref.

The survival of viruses in sewage sludge was investigated under varying conditions of pH, temperature, and time in laboratory experiments. Titers of viruses in sewage sludge maintained at pH 6.0, 6.5, 7.5, 8.5, and 9.5 indicated that maximum enterovirus elution occurred at pH 9.5. Chloroform did not affect the infectivity of attenuated poliovirus type 1, coxsackievirus B5, and echovirus type 6. Viral concentrations in sewage sludge maintained at room temperature (22 C) and at 4 C were unchanged after 7 days and were smaller in amount after 14 days. Larger quantities of poliovirus survived at 4 C than at 22 C after 14 days. The survival of various enteroviruses in digested sludge at 22 C was observed over a period of 12 weeks. Coxsackievirus A9 survived less than 2 weeks; coxsackievirus B2 and B4 survived less than 5 weeks; and coxsackievirus B5 survived the entire 12 weeks of the experiment. Echovirus type 6 was evident through the 10th week and type 9 survived through the 12 weeks. Virulent polio type 3 and vaccine polio type 1 persisted until the 8th week; polio vaccine type 3 and virulent polio type 1 were present in the 10th week. Echovirus type 6 survived 10 weeks while the echovirus type 9 was detected through the entire 12 weeks. The viruses survived longer in sludge than in another medium. Separate tests with reovirus type 2 demonstrated a survival period of 6 weeks.

E144
RELATION BETWEEN DEHYDRABILITY AND PROPERTIES OF SEWAGE SLUDGE (Report I)
(Gesuiodei no shoseijo to dasseuisei ni tsuite),

Yokoyama, M., Nozawa, F., Toda, S., and Kondo, Y.

Ebara Infiruko Jiho, No. 72, p 2-11, 1978. 3 fig, 9 tab.

Chemical and physical techniques were employed to measure the properties of digested and undigested sewage sludge. The dewaterability of sewage sludge was considered to be best described by the capillary suction time. Differences in concentratibility and particle size were less apparent in tests with different sludges than in capillary suction time measurements. The capillary suction time index was used to determine the optimum rate of ferric chloride and slaked lime feed to sewage sludge during dewatering. Polyelectrolyte conditioning, which impeded the removal of the sludge cake and increased the water content of certain sludges, was not considered generally applicable.

E145
THE DISTRIBUTION OF HEAVY METALS IN ANAEROBIC DIGESTION,

Hayes, T. D., and Theis, T. L.

Cornell University,
Ithaca, New York,
Department of Agricultural Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 61-72, January, 1978. 15 fig, 5 tab, 21 ref.

The distribution of heavy metals in anaerobic digesters was investigated using three bench-scale anaerobic digesters fed with sewage containing varying concentrations of heavy metals. Nitrate salts of chromium, copper, nickel, zinc, cadmium, and lead and dichromate were fed to the digesters in concentrations ranging from 5-15,000 mg/liter by step or pulse feed applications over a period of 10 days. Sludge samples taken during the digestion process were separated into soluble, precipitated, extracellular, and intracellular fractions for heavy metal analysis. Decreasing gas generation, methane concentrations, and organic acids accumulation were monitored as indicators of anaerobic digestion disruption by heavy metals. The toxicity impact of the heavy metals on anaerobic digestion followed the relationships: nickel > copper > lead > chromium > zinc, with no toxic impact observed for the cadmium doses. Heavy metal concentrations in the digester were distributed between the insoluble or precipitated fraction and the intracellular or biomass fraction, with little of the metals evident in the extracellular fraction. Levels of heavy metals which would produce inhibition and toxicity during anaerobic digestion were calculated.

E146
MONITORING POLLUTION,

Surveyor, Vol. 151, No. 4469, p 22, February, 1978.

A dissolved oxygen and temperature monitor has been developed by pHOX Systems Ltd. of Baldock, Herfordshire, England. The Series 67 measures and records the dissolved oxygen data in percent saturation or mg/liter. The self-contained, waterproof unit was designed for remote field stations and waste water treatment plant trials. The unit is operated by an internally-mounted cell with a one-month power supply; overnight recharging restores the one-month power supply. Dissolved oxygen and temperature levels are measured by a patented cartridge-type pHOX Mackereth electrode. The inkless 'chopper bar' type recorder for maintaining oxygen and temperature values is available with a variety of chart speeds.

E147

MICROSCOPIC OBSERVATION OF ACTIVATED SLUDGE APPLIED TO THE MONITORING OF TREATMENT PLANTS (L'observation microscopiques des boues activees applique a la surveillance des installations d'epuration: Technique d'etude interpretation),

Drakides, C.

Laboratoire de Genie Chimique,
Traitement et Epuration des Eaux,
Universite des Sciences et Techniques du Languedoc,
Montpellier, France.

Techniques et Sciences Municipales-l'Eau, Vol. 73, No. 2, p 85-98, February, 1978. 18 fig. 16 ref.

Observations of macroscopic and microscopic activated sludge characteristics are forwarded as a means of monitoring the operation of biological waste water treatment plants. Clear or slightly turbid supernatant (transparency of 40-80 cm or more) is considered indicative of efficient operation and low BOD and COD levels in the effluent. A high degree of purification is also represented by: the presence of a light, white flexible froth; the characteristic odor of moist earth; particles measuring 20-50 microns; non-filamentous free bacteria counts in the range of 10 to the 10th to 10 to the 11th/liter; and a diverse microfaunal assemblage in normal abundances.

E148

TEEPOL AND TRITON MEDIA FOR THE ENUMERATION OF ESCHERICHIA COLI BY MEMBRANE FILTRATION,

Opara, A. A., Mara, D. D., and Wheater, D. W. F.

The University,
Dundee, Scotland,
Department of Civil Engineering.

Water Research, Vol. 11, No. 11, p 949-954, 1977. 11 tab, 20 ref.

More accurate techniques of E. coli enumeration in waste, river, and esturine waters were investigated by varying the concentration of Teepol broth and modifying Triton agar broth for use with membrane filtration. False E. coli counts inaccurate by up to 25% have resulted from utilizing membrane-enriched Teepol broth at 44 C. In this study, the concentration of basal Oxoid membrane-enriched Teepol broth was varied from 0-7%. A Triton agar broth containing 2 ml of the non-ionic surfactant Triton X-100 was membrane-enriched for use in filtration. Control groups cultured in tryptone mannitol broth and tryptone lactose formate broth were retested using lactose peptone water and tryptone water when negative results occurred. Millipore membranes were used for filtration. False positive enumerations of E. coli were reduced to 8.9% when the Teepol concentration was reduced from 0.4 to 0.2%. Enumeration errors were reduced to 6.8% when E. coli in 0.2% Triton in a membrane-enriched agar medium were filtered through membranes at 44 C.

E149

COMPARISON OF ADSORPTION ELUTION METHODS FOR CONCENTRATION AND DETECTION OF VIRUSES IN WATER,

Fattal, B., Katzenelson, E., Hostovsky, T., and Shuval, H. I.

Hebrew University-Hadassah Medical School,
Jerusalem, Israel,
Environmental Health Laboratory.

Water Research, Vol. 11, No. 11, p 955-958, 1977. 4 tab, 20 ref.

Removal of poliovirus and enteroviruses from sewage was tested with aluminum hydroxide precipitation, cellulose nitrate membrane filtration and glycine buffer elution, insoluble polyelectrolyte treatment, and cellulose nitrate filtration with beef extract elution. The control aluminum hydroxide precipitation techniques recovered an average of 50% of the poliovirus. The cellulose nitrate membrane filter with glycerine buffer elution recovered an average of 65%. Seventy-seven per cent of the poliovirus was removed on the cellulose nitrate membrane filter with a 3% beef extract solution. The insoluble polyelectrolyte (PE 60) removed an average of 70% of the poliovirus. Enterovirus recovery from sewage averaged 40% with aluminum hydroxide precipitation, 111% with membrane filtration and beef extract elution, 67% on the membrane filter with glycerine buffer, and 80% with PE 60. In experiments with echovirus 7, poliovirus, and enterovirus seeded in tap water, recovery rates were higher than those from sewage.

E150

DETERMINATION OF TOCL BY ENRICHMENT ON POWDERED ACTIVATED CARBON AND FLOCCULATION (Unterschungen zur Bestimmung de organisch gebundenen Chlors mit Hilfe eines neuartigen Anreicherungsverfahren),

Kuhn, W., Fuchs, F., and Sontheimer, H.

Zeitschrift fuer Wasser- und Abwasserforschung, Vol. 10, No. 6, p 192-194, 1977. 2 fig, 3 tab, 3 ref.

Enrichment of chlorine compounds on powdered activated carbon followed by flocculation was performed as a preliminary to pyrohydrolysis detection of total organic chlorine. Conventional concentration techniques for chlorine compounds utilized granular activated carbon is a miniature sampler unit. The described enrichment procedure employs powdered activated carbon for step-by-step adsorption of chlorine compounds at pH 5. Enrichment is followed by flocculation with 100 mg aluminum and 8 mg polymer at pH 6.5 for 10 min. The detection range of this analytical technique is reported to be about 20 micrograms of total organic chlorine/liter.

E151
AUTOMATIC CONTROL OF A DIFFUSED AIR TREATMENT PLANT,

Thurley, B. L.

Brown Boveri Review, Vol. 64, No. 11, p 693-698, November, 1977. 6 fig.

Automatic monitoring and control systems are described for diffused air aeration waste water treatment facilities. Debris buildup on the raking screens and sludge accumulation in the digester can be monitored by a Deltapi E transmitter with air fed Pneumerstats; data can be displayed on a milliammeter indicator and computing bin. Venturi flume throat constricters in grit channels are employed as flowmeters when connected to a Lea series A recorder or transmitter. This series can be used to control a penstock for maintaining appropriate flows. Sediment removal from the primary settling tanks, final sedimentation tanks, and storm tanks is controlled by ultrasonic sludge level detectors. A Veriflux magnetic flowmeter, connected to Flexel LB-52 flow controllers, and a computing bin maintain the flow of air in the diffused aeration system. Activated sludge return is measured by the Veriflux meter; Simplex high-intensity aeration cones control the aeration intensity by varying the rotational speed. Mackereth lead anodes, surrounded by a cathode contained in a semipermeable polyethylene membrane, monitor the dissolved oxygen content of the effluent. Kent Deltapi E transmitters are also used to measure gas pressures in the digesters. Analog displays can be connected to digital telemetry systems for data collections in large plants.

E152
CATALYSTS USED TO REPLACE SILVER SULFATE IN COD,

Water and Wastes Engineering, Vol. 15, No. 3, p 14, March, 1978.

Alternatives to sliver sulfate determination of COD at various concentrations in waste water were explored. Less costly catalysts were examined to replace the conventional COD testing methods. Magnesium sulfate employed in conjunction with a smaller quantity of silver sulfate was efficient for detecting COD concentrations in the range of 50-500 mg/liter. COD determinations using magnesium sulfate as a catalyst were comparable to test results when silver sulfate was used alone. A combination of silver sulfate, aluminum sulfate, and magnesium sulfate was accurate to 5-50 mg/liter COD. Results comparable to the conventional silver sulfate catalyst technique were obtained with the combined catalysts.

E153
MOISTURE DETERMINATION BALANCE SPEEDS UP TOTAL AND VOLATILE SOLIDS ANALYSIS,

LaSpina, A. J.

Florham Park Sewage Treatment Plant,
Florham Park, New Jersey.

Water and Sewage Works, Vol. 125, No. 2, p 61, February, 1978.

The Ohaus 6010 moisture determination balance, installed in the Florham Park, New Jersey, sewage treatment plant, has reduced the time required for total and volatile suspended solids calculations in sewage samples from 5-6 hrs for the conventional method to 15-20 min. The technique employs infrared radiation to evaporate liquids in the waste water. A 10 g waste sample is placed on a pan and subjected to infrared heat for 10 min. The weight loss of the sample due to moisture loss during heating and the percentage moisture are displayed on a readout in the balance. The residual solids are then reduced to ash by further heat treatment to remove volatiles. The percentage of volatile and total solids are then calculated from the moisture content and the residual ash weight. The Ohaus 6010 balance does not require constant monitoring by a technician.

E154
FORMATION OF POLYCHLORINATED AROMATIC COMPOUNDS DURING AQUEOUS CHLORINATION,

Smith, J, G., McCall, R. B., and Chan, P. K.

Guelph-Waterloo Center for Graduate Work in Chemistry,
Waterloo University,
Ontario, Canada,
Department of Chemistry.

Environmental Pollution, Vol. 14, No. 4, p 289-296, 1977. 3 tab, 23 ref.

Naphthalene and biphenyl were reacted with aqueous solutions of chlorine under homogeneous (10 ppm) and non-homogeneous (500 ppm) conditions. A 100 ml hypochlorous acid solution was mixed with 50 mg of the hydrocarbon at room temperature in the non-homogeneous tests. At pH 6, all of the naphthalene was converted to chlorinated compounds. Biphenyl was not as reactive as naphthalene at 500 ppm but was more reactive than chlorinated biphenyl. Decreasing the pH from 7 to 2 at 500 ppm biphenyl increased the formation of dichlorobiphenyls as biphenyls decreased. When the pH decreased from 6 to 4, naphthalene at 10 ppm was converted to chlorinated hydrocarbons. The non-homogeneous concentration of naphthalene was more readily reacted with chlorine. In the 500 ppm biphenyl solution at pH 6, 60% of the biphenyl was converted while only 2.5% of a 6 ppm biphenyl solution reacted with active chlorine, even after 120 hrs. The nature of the chlorinating agent was affected by pH and influenced the non-homogeneous reaction; chlorine was represented as hypochlorous acid at pH 4 to 6, while at a lower pH free chlorine was present.

E155
AUTOMATIC CONTROLS PREVENT CHLORINE SPILL HAZARDS,

Last, H.

American City and County, Vol. 93, No. 5, p 89-90, May, 1978. 1 fig.

A chlorine scrubbing system installed in the Tonawanda, New York, waste water treatment plant chemically neutralizes chlorine spills automatically. The system contains five chlorine detectors installed at floor level in the chlorine storage room and chlorine feed room to seal off the rooms and stop the ventilation system when chlorine is detected in the air. An alarm is activated and the scrubbing system pumps create a draft to circulate the chlorine contaminated air through one or more of the three ejector venturi scrubbers. The chlorine is neutralized with caustic sodium hydroxide solution in the venturi scrubbers and neutralized air is recirculated through mist eliminators to the room where the leak originated. The scrubbing system continues to operate until the chlorine content in the air is reduced to 1 ppm. The use of caustic soda does not significantly change the character of the treatment plant effluent which is discharged into the Niagara River.

E156
SIMULTANEOUS DETERMINATION OF TRACE METALS IN INDUSTRIAL AND DOMESTIC EFFLUENTS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY,

Kinard, J. T.

Benedict College,
Columbia, South Carolina,
Department of Chemistry.

Journal of Environmental Sciences and Health, Vol. A12, No. 10, p 531-547, 1977. 3 fig, 6 tab, 12 ref.

Differential pulse anodic stripping voltammetry, following Parr acid digestion bomb treatment, was tested for the simultaneous analysis of trace metals in industrial and domestic wastes. Effluent from textile, printing, meat packing, slaughter house, soft drink, dyeing and finishing, steel mill, aluminum, egg processing, and chicken farm industries and domestic wastes were placed as 0.1-10 ml samples in a Teflon digestion cup containing 2.5-3 ml nitric acid and heated to 200 C. The samples were heated 2-7 hrs, cooled, and diluted with sodium acetate to pH 5.5-5.8. The solutions were purified on a Chelex 100 column and placed in an electrolysis cell for analysis. Recovery of zinc, cadmium, lead, bismuth, and copper during simultaneous determinations by the differential pulse anodic stripping voltammetry technique ranged from 93.9-107%. The technique was superior to atomic absorption in terms of detection limits, sensitivities, and cost.

E157
MEASURING WASTEWATER FLOW WITH DYE,

Foster, W. S.

American City and County, Vol. 93, No. 5, p 38, May, 1978.

Rhodamine WT dye, supplied by E. I. DuPont de Nemours and Co., was used in a dye-dilution tracing method for short-term monitoring of flows in sewers and for calibrating weirs, flowmeters, and flumes. Rhodamine has a specific gravity of 1.2 and a viscosity that requires it be diluted with water to increase the injectable rate above 10 ml/min. The dye is dispersed into the flow at a constant rate by a constant-feed pump or a Mariotee vessel; a sampling unit is installed at a sufficient distance downstream from the injection point to insure adequate mixing. The flow rate of the waste water is calculated as the product of dye injection rate and the ratio of initial dye concentration to sampled dye concentration. The dye tracer technique is also appropriate for measuring pump performance, settling and chlorine basin efficiency, canal and stream flow rates, and effluent dilution in receiving water bodies.

E158
FISH COUGH RESPONSE--A METHOD FOR EVALUATING QUALITY OF TREATED COMPLEX EFFLUENTS,

Carlson, R. W., and Drummond, R. A.

United States Environmental Protection Agency,
Environmental Research Laboratory-Duluth,
Minnesota.

Water Research, Vol. 12, No. 1, p 1-6, 1978. 2 fig, 2 tab, 22 ref.

Blue gill sunfish cough responses to treated effluent were investigated as a means of evaluating the toxicity of municipal and industrial wastes mixed in varying concentrations with receiving waters and Lake Superior water. Fish were exposed to different waste concentrations in an electrode chamber. Sunfish died in all experiments with chemical plant effluent concentrations of 56% and uranium mine effluent concentrations above 18%; the cough response of the fish increased by 505% in a 1.0% uranium mine solution. A 50% death rate occurred in ammunition wastes of 0.75-1.0% while the cough response increased as much as 774% in concentrations of 0.56%. A decrease in sunfish response when pulp mill effluent concentrations increased from 56-75% was attributed to the individual tolerance levels of the fish tested. Cough responses increased by the same order when fish were exposed to 75% concentrations of both chlorinated municipal effluent and receiving water. Cough responses remained the same after 2 days for carpet mill, pulp mill, and chemical plant effluents while responses to the other samples declined. Concentrations of 0.8-6.0% of refinery effluent produced a cough response increase of 122-709%.

E159

BIODEGRADABILITY TESTING AND ITS RELEVANCE TO ENVIRONMENTAL ACCEPTABILITY,

Gilbert, P. A., and Watson, G. K.

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Wirral, Merseyside, England.

Tenside Detergents, Vol. 14, No. 4, p 171-177, 1977. 3 tab, 36 ref.

Definitions, techniques, and limiting parameters of biodegradability of municipal waste water are reviewed. Distinctions are made between biodegradation, biodegradability, functional biodegradation, environmentally acceptable biodegradation, ultimate biodegradation, complete mineralization, bio-elimination, biological hardness, and biological softness. Definitions are also provided for elimination, acclimatization, biomass, constitutive enzymes, die-away testing, enrichment or elective culture techniques, inducible enzymes, inoculation, inoculum, and substrate. Conditions influencing biodegradation include: acclimatization, enzymatic co-oxidation, waste concentration inhibition, temperature, pH, inorganic salt composition and concentration, and the presence of certain compounds during testing. Test methods are classified as: die-away techniques where only the test compound is present; die-away techniques, where other organic carbon sources besides the test compound are present; and activated sludge techniques. Analytical techniques include specific chemical analysis for each compound, radio-labelled compound, oxygen uptake and carbon dioxide generation, dissolved organic carbon, COD, biomass, and pure culture analysis. Limitations, advantages, and selection of the testing procedures are reviewed.

E160

THE COMPARISON OF ACTIVATED AND DIGESTED SLUDGE EXTRACTS IN CULTIVATING CHLORELLA PYRENOIDOSA AND C. SALINA,

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The Chinese University of Hong Kong,
Shatin, Hong Kong,
Department of Biology.

Environmental Pollution, Vol. 14, No. 3, p 207-211, 1977. 2 fig, 1 tab, 11 ref.

Chlorella pyrenoidosa and Chlorella salina were cultured in activated sludge and digested sludge extracts, Kuhl medium, and MAV enrichment medium for 11 days at 25 C with a relative humidity of 70-80% and a daily 16 hr light cycle. The highest growth rate of Chlorella pyrenoidosa was observed in a medium containing 2% digested sludge extract, followed by 2% activated sludge extract, with Kuhl medium exhibiting the lowest growth rate. Chlorella salina growth rate was highest in the 2% activated sludge extract, followed by the 2% digested sludge extract. Growth rates were lower in the 3% activated and digested sludge extracts, with the MAV enrichment medium demonstrating the lowest growth. The sludge extracts were analyzed directly rather than after leaching with ammonium acetate; the activated sludge was found to contain higher concentrations of NH3-N, Mg, K, Cd, Cr, Fe, Pb, and Zn; digested sludge had higher concentrations of total-N, Ca, water soluble-P, Cu, and Mn.

E161

THE BACTERIAL METABOLISM OF 4,4'-DICHLOROBIPHENYL, AND ITS SUPPRESSION BY ALTERNATIVE CARBON SOURCES,

Tulp, M. T. M., Schmitz, R., and Hutzinger, O.

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The Netherlands,
Laboratory of Environmental and Toxicological Chemistry.

Chemosphere, Vol. 7, No. 1, p 103-108, 1978. 2 fig, 26 ref.

Gas chromatography-mass spectrometry (GC-MS) was used in experiments to examine the metabolism of 4,4'-dichlorobiphenyl by activated sludge bacteria. In shake culture studies, 50 ppm of the test compound, dissolved in ether, was added to vessels containing an inoculum of sludge supernatant. D-glucose, glycerol, peptone, yeast extract, and humic acid were used as alternate carbon sources for an unsedimented activated sludge inoculum. In soil studies, the test compound was continuously filtered through an inoculated column containing garden soil and coarse sand. The metabolites were isolated at the termination of the experiments by acidification with H2SO4, hydrolysis, three ether extractions, and centrifugation. Retention times and relative intensities during GC-MS revealed that 4-chlorobenzoic acid and 4,4'-dichloro-2,3-biphenyldiol were the major byproducts of 4,4'-dichlorobiphenyl metabolism. The formation of these metabolites by the mixed bacterial populations in the activated sludge cultures was suppressed to below detection limits when alternate carbon sources were made available. No metabolites were detected in similar experiments with higher chlorinated isomers, including 2,4',5-tri-, 2,2',5,5'-tetra-, 2,2',3,4,5'-penta-, 2,2',3,4,5,5'-hexa-, and decachlorobiphenyl.

E162

ENVIRONMENTAL BEHAVIOR OF ANIONIC AND NONIONIC SURFACTANTS (Das Umweltverhalten anionischer und nichtionischer Tenside),

de Oude, N. T. V.

Prater and Gamble European Technical Center,
Grimbergen, Belgium.

Tenside Detergents, Vol. 14, No. 4, p 189-194, July-August, 1977. 7 fig, 6 tab, 14 ref.

The distribution and toxicity of anionic and nonanionic surfactants in a receiving stream were investigated at a Belgian community without sewage treatment facilities. During the first part of 1976, 85 families recorded their use of detergent supplied for household use during the test period. Samples of river water were collected periodically above and at a sewage outfall, and 1 km below the outfall. The samples were chemically and physically analyzed for detergent components concentrations, degradation, and mineralization with die-away tests. The river and waste waters at the three sampling sites were analyzed with an Azure A reactive substance for anionic surfactants, similar to the methylene blue techniques and Cobalt-thiocyanate method for nonionic detergents. Boron concentrations were also recorded as an indicator substance normally not found in the water or wastes. Toxic units calculated from modified toxicity tests in the water ranged from 3.05-6.90 while 44.1-87.5% Azure A reactive substance was found.

E163

ISOLATION OF SALMONELLAE FROM SEWAGE WITH A NEW PROCEDURE OF ENRICHMENT,

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Journal of Applied Bacteriology, Vol. 44, No. 2, p 233-239, 1978. 3 tab, 13 ref.

A total of 151 strains of salmonellae belonging to 27 serotypes were isolated by three enrichment methods using municipal wastes samples collected from the sewer system in Athens, Greece. Sewer samples collected by 40 gauze-wrapped Moore swabs were incubated in 200 ml buffered peptone broth for 18-22 hrs at 37 C; 0.1 ml aliquots of the peptone media were then enriched at 37 C for 48 hrs in Rappaport's medium formula R25, at 43 C for 48 hrs in R10 medium, or at 34 C for 48 hrs in Muller-Kauffmann's tetrathionate broth. Subcultures were derived for each of these enrichment media on brilliant green-deoxycholate agar and incubated for 24 hrs at 37 C. Of the 27 serotypes isolated, four were formerly unreported in Athens' sewage. The Rappaport enrichment media isolated more serotypes and strains than the tetrathionate broth. R10 at 43 C isolated 103 strains and 24 serotypes; R25 at 37 C isolated 82 strains and 19 serotypes; and M-K tetrathionate broth isolated 25 strains and 11 serotypes. While the R10 medium yielded more salmonellae serotypes and strains, the growth of competing organisms was inhibited in this media compared to the other two media. Smaller quantities of inoculum were required for the Rappaport enrichment media.

E164

QUANTITATIVE ANALYSIS OF HYDROCARBONS IN SEWAGE SLUDGE FROM WASTE WATER PURIFICATION STATIONS,

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Geneve, Switzerland.

Travaux de Chimie Alimentaire et d'Hygiene, Vol. 69, No. 1, p 96-108, 1978. 6 fig, 2 tab, 9 ref.

A gas chromatography technique, incorporating pentane-benzene elution and pentadecane as an internal standard, permitted polycyclic aromatic hydrocarbon quantification in sewage sludge samples with varying solids contents. The technique, which employed direct hydrolysis of sewage sludges containing 40-95% water rather than Soxhlet extraction, was tested on sludge samples obtained from five Swiss waste water treatment plants. A 10 g sample of sludge was homogenized and hydrolyzed with a 30 ml solution of methanolic potassium hydroxide for 1.5 hrs, followed by the addition of 25 ml pentane. Duplicate sludge samples were mixed with pentane and 0.25 micrograms pentadecane to provide an internal standard. In some of the samples, pentane elution was incomplete and a pentane-benzene solution was added to elute polar hydrocarbons. The sample was filtered, adjusted to pH 2.5, and extracted with 25 ml pentane. The sample was then placed in a column containing 40 g activated silica gel in pentane, eluted with 250 ml pentane-benzene, concentrated to 0.2-1.0 ml, and analyzed by gas chromatography at 120-320 C. The total areas of the sample peaks were compared to corresponding pentadecane peaks, employed as an internal standard. Results correlated well with predicted surface areas when high concentrations of hydrocarbons were present. Hydrocarbon recovery ranged 96.0-98.9% in samples bearing more than 50% solids.

E165
RECOVERY OF ASCARIS EGGS FROM SLUDGE,

Meyer, K. B., Miller, K. D., and Kaneshiro, E. S.

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Ohio,
Department of Biological Sciences.

Journal of Parasitology, Vol. 64, No. 2, p 380-383, April, 1978. 2 tab.

The zinc sulfate concentration technique for quantifying Ascaris ova in sewage sludge was enhanced by pretreatment with hypochlorite and an anionic detergent. A 75 g sample of mixed sludge seeded with Ascaris eggs was mixed with 100 ml of 2.62% hypochlorite, swirled, mixed with additional hypochlorite to obtain a 225 ml volume, and allowed to react for 50 min. The sample was centrifuged at 4 C for 2 min and the solids fraction was mixed with 2 ml of anionic detergent and distilled water to a 225 ml volume. The mixture was centrifuged again, washed twice with distilled water, mixed with 75 ml of 33.2% zinc sulfate solution, and then centrifuged. The supernatant containing the eggs was passed through an 0.45 micron membrane filter; the recovered eggs were incubated in the dark for 10 days at 25 C. The hypochlorite and anionic detergent treatment recovered 71% of the eggs, compared to 38% recovery with hypochlorite alone. Higher recovery rates were obtained when larger quantities of eggs were seeded in the sludge. Hypochlorite did not interfere with egg viability or destroy nonviable eggs.

E166
PRACTICAL METHOD FOR DETECTING POLIOVIRUS IN ANAEROBIC DIGESTER SLUDGE,

Glass, J. S., Van Sluis, R. J., and Yanko, W. A.

North Carolina University,
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Department of Environmental Science and Engineering.

Applied and Environmental Microbiology, Vol. 35, No. 5, p 983-985, 1978. 2 tab, 10 ref.

Poliovirus was eluted from anaerobic digested sludge and dewatered composted sludge with beef extract addition, sonic disruption, and dithizone-chloroform extraction. A 47% poliovirus recovery was achieved when 10 mg sludge solids were suspended in 200 ml of 3% beef extract, disrupted by sonic treatment for 2 min, and centrifuged for 20 min; eluted viruses were assayed on monolayers of Buffalo green monkey kidney cells cultured in a medium with 10% fetal bovine serum. Virus recovery was increased to 60-65% when the beef extract eluates were concentrated to 8-12 ml by organic flocculation. The poliovirus isolation frequency was 100% when the elution and concentration method was applied to undigested liquid sludge, digested liquid sludge, and dewatered digested sludge. Poliovirus isolation in dewatered digested sludge, composted for 6 or more days, was limited because of mammalian monolayer cell death attributed to toxic concentrations of heavy metals formed by organic flocculation of digester solids eluates. Detoxification of the cytotoxic concentrates was achieved by extraction of the concentrated eluates with dithizone in chloroform. Poliovirus recovery after solvent extraction averaged 98.9%. The elution-concentration-extraction technique had a detection limit of about 1 infective virus unit/concentrated sample.

E167

APPLICATION AND DETERMINATION OF ORGANIC POLYMERS,

Wang, L. K., Wang, M. H., and Kao, J-F.

Water, Air, and Soil Pollution, Vol. 9, No. 3, p 337-348, 1978. 6 fig, 67 ref.

Organic polymer applications to water and waste water are reviewed and a method to measure anionic and cationic polyelectrolytes is described. Cationic polyelectrolytes are employed as coagulants where colloids and suspended solids are negatively charged. Nonionic organic polymers are added after the onset of flocculation to agglomerate colliding particles; they can also remove phosphates when used in conjunction with ferric chloride. Anionic polymers assist in the agglomeration of negatively charged particles that have been neutralized by inorganic cations. Anionic polyelectrolytes are added as coagulation aids with alum or ferric chloride as the principle coagulants. Organic polymer treatment of waste water can enhance sedimentation, sand filtration, diatomaceous earth filtration, ultrafiltration, reverse osmosis, flotation, or centrifugation. Quantitative analysis of 0.0002-0.005 N concentrations of anionic and cationic polyelectrolytes is performed by dilute and regular direct titration with corresponding cationic and anionic titrants. Calibration curves determine the normality of cationic polyelectrolytes titrated with poly(vinylsulfuric acid) potassium and anionic polyelectrolytes titrated with 1,5-dimethyl-1,5-diazaundecamethylene.

E168

GROWTH AND METAL UPTAKE ON SNAP BEANS GROWN ON SEWAGE SLUDGE-AMENDED SOIL: A FOUR-YEAR STUDY,

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Journal of Environmental Quality, Vol. 7, No. 2, p 252-257, April-June, 1978. 7 fig, 3 tab, 18 ref.

A four-year study evaluated the trace metal uptake by snap beans (Phaseolus vulgaris) grown in sandy Udorthentic Haploboroll soil amended with anaerobically-digested sludge at total application rates of 350, 700, and 1,400 metric tons/ha. Subsequent crops received a single sludge application of 112, 225, or 450 metric tons/ha. Sludge application increased soil pH from 5.3 to a maximum of 6.5; crop yields increased with sludge amendments and often surpassed yields of commercially fertilized control plants. Zn and Cu concentrations in the bean tissue increased with sludge application. Zn continued to accumulate after the second application and stabilized after the third and fourth applications; Cu uptake levelled off after the initial sludge application. While these concentrations stabilized in the tissue, they did not decrease after sludge treatment was terminated. The concentration of Cd in edible bean tissue never exceeded 0.09 micrograms/g, regardless of the sludge application rate or schedule. Zn and Cu concentrations also increased in the leaf portion of the plants after sludge application.

E169

BACTERIAL DEHALOGENATION OF HALOGENATED ALKANES AND FATTY ACIDS,

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Applied and Environmental Microbiology, Vol. 35, No. 5, p 867-871, 1978. 6 tab, 10 ref.

Unacclimated sewage sludge was capable of releasing halides from 1,9-dichlorononane, 1-chloroheptane, and 6-bromohexanoate. None of the sludge organisms could utilize the 1,9-dichlorononane as the sole growth medium. Resting Pseudomonas cells derived from n-undecane grown cultures released more chloride from 1,9-dichlorononane in the absence of chloramphenicol; cells derived from glycerol-grown cultures dehalogenated 1,9-dichlorononane, except in the presence of chloroamphenicol. Five n-undecane-utilizing bacteria were used to test for the possibility of an enzyme-catalyzed reaction by a non-specific dehalogenase. None of the five bacteria could subsist on 1,9-dichlorononane, but rest cells from 24-hr n-undecane cultures catalyzed chlorine release. Four of the five bacteria dehalogenated 1-chloroheptane; all five dehalogenated 6-bromohexanoate. Sewage samples incubated with n-undecane or 1,9-dichlorononane showed a greater tendency for n-undecane utilization or dehalogenation, respectively. Possible dehalogenation processes were attributed to: an inductible enzyme; co-metabolism and constitutive latent enzymes; or a different enzyme issued to cleave two substituted fatty acids.

E170

WATER POLLUTION TESTS - BIOCHEMICAL OXYGEN DEMAND (BOD),

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Palo Alto, California.

Water and Sewage Works, Vol. 125, Reference Number, p 186-187, April, 1978.

A method to measure BOD in raw sewage, primary, secondary, and final dechlorinated effluent is presented. A sewage seed is obtained by filtering a 1-liter sample of primary effluent which has been incubated for 24 hrs at 20 C. The supernatant is filtered through glass wool, frozen, and analyzed for BOD using 1 ml of seed. In sterilized BOD bottles, several milligrams of allyl thiourea and 1 ml seed are mixed with 2 samples each of 10 ml raw sewage, 10 ml primary effluent, 50 ml secondary effluent, or 50 ml final effluent and filled with a prepared diluent. Half of the samples are incubated at 20 C for five days; dissolved oxygen (DO) concentrations are then calculated. DO concentrations in the other samples are determined within 15 min of preparation. DO is calculated by adding 2 ml manganous sulfate solution and 2 ml alkaline-iodide-sodium azide solution, stoppering, and then shaking the bottle. The sample is acidified with 2 ml H2SO4, stoppered, shaken to dissolve the precipitate, and titrated. Starch is added if the mixture is not tinted brown; no DO is present if no blue color develops. A brownish solution is titrated with sodium thiosulfate until a pale yellow is achieved. Starch is added and the mixture is further titrated until the blue disappears. The volume of sodium thiosulfate equals the DO concentration. With this value, BOD is calculated as a function of the initial and final DO concentrations, the seed factor, the sample volume, and a constant.

E171

CHLORINATED ORGANICS AS A FACTOR IN REDUCED BIOLOGICAL OXYGEN DEMAND (BOD),

Carlson, R. M., and Long, D. W.

Minnesota University,
Duluth,
Department of Chemistry.

Journal of Environmental Sciences and Health, Vol. A13, No. 2, p 177-186, 1978.
5 tab, 11 ref.

The contribution of the chlorinated organic forms of phenols, benzoic acids, and anilines to BOD reduction during waste water chlorination was compared to the impact exerted by the original phenols, benzoic acids, and anilines present in the waste water. A 5 ml aliquot of a standard solution containing 150 mg/liter each of reagent grade glucose and glutamic acid was seeded with 1 ml/liter settled domestic sewage and mixed with 0.001 M aliquots of phenol, benzoic acid, and anilines, and their chlorinated derivatives. BOD determinations were made after one to five days of incubation at 20 C. Aniline was found to be the most resistant of the three parent organics to degradation. The second order chlorinated organics were more resistant to degradation when the parent organic was significantly degradable. Metabolic activity was not reduced by any of the chlorinated organics except 4-chloro-3-methylphenol; the chloroorganics were not found to contribute to BOD values. When both the parent organic and the chlorinated derivative were present, the BOD was attributable only to the parent. It was concluded that the chlorinated second order organics were not readily degradable within the test period and will not be represented by the resulting BOD value.

E172

CHLORINATED SOLVENTS IN SEWAGE WORKS,

Brown, D.

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Brixham Laboratory,
England.

Effluent and Water Treatment Journal, Vol. 18, No. 3, p 110, 112-113, 115-117, March, 1978. 5 tab, 8 ref.

Raw, settled, and final effluent sewage samples from six English sewage treatment plants were analyzed for chlorinated organic solvents (trichloroethylene, perchloroethylene, alpha-trichloroethane, and chloroform). The plants employed diffused air activated sludge, surface aeration activated sludge, trickling filters with or without a Passavant ditch, or double filtration after activated sludge treatment. Chloroform levels in the effluent after biological treatment and in the biological and digested sludges in two treatment plants were below detection limits; chloroform levels were high in primary sludge from a trickling filter plant but were lower in the final effluent (0-102 micrograms/liter) and in the biological sludge (100 micrograms/kg). Alpha-trichloroethane was not detected in the biological and digested sludge from two plants or in the final effluent of one of these; a mean level of 1 microgram/liter was found in the other plant effluent. Trichloroethylene was apparent in two final effluent samples at mean concentrations of 45 and 5-13 micrograms/liter. Low levels of the solvent were found in sludges from three of the plants sampled. Low levels of perchloroethylene were found in final effluent and sludge samples at four of the plants; the mean effluent concentration was 144 micrograms/liter in an activated sludge plant, with negligible amounts in the digested sludge. The removal of chlorinated hydrocarbons was considered to result from biodegradation and/or volatilization; the chlorinated aliphatics entering with the raw sewage were passed on to biological treatment and not preferentially absorbed by primary sewage.

E173
SUB-SERVICE SURVEYING,

Water and Waste Treatment, Vol. 21, No. 6, p 29, June, 1978.

The electro-magnetic subsurface GPR 104 Drain Locator, manufactured by Electrolocation Ltd. of Bristol, England, eliminates the need to excavate trial holes in locating the course of uncharted drains or sewers. A probe is rodded, jetted, or floated through the pipe; signals are transmitted by the probe to a hand-held surface receiver equipped with earphones. The GPR 104 Drain Locator has reportedly saved the Cheltenham Borough in England the large expense of excavating the trial holes generally required to locate and map subsurface drains.

E174
SELECTED PROBLEMS OF TREATMENT AND DISPOSAL OF DOMESTIC SEWAGE,

Zanker, A.

Water and Sewage Works, Vol. 125, Reference Number, p 182-185, April, 1978. 3 fig, 1 tab, 2 ref.

A nomograph was used to calculate the maximum BOD load that may be discharged into a receiving stream without causing a specific oxygen deficiency downstream. The nomograph was developed as a simpler alternative to the Thomas equation. The ratio of the reaeration rate to the deoxygenation rate in the stream is first calculated for use in the nomograph. The actual dissolved oxygen deficit upstream and the maximum allowable deficit downstream are plotted on the primary scale and their linear value intersected with the first reference line using a straight edge. The intersection point is then transferred to a second reference line; a second intersection point is labelled, using oblique tie-lines. This point is connected to the value of the reaeration:deoxygenation ratio and extended to intersect with another reference line. This reference point is connected to the value of the maximum allowable dissolved oxygen deficit downstream plotted on a secondary scale; the maximum BOD load is read at the intersection point of this line on the secondary scale. The value obtained is then multiplied by the average flow of the stream.

E175

ASSESSMENT OF THE TRACE ORGANIC MOLECULAR COMPOSITION OF INDUSTRIAL AND MUNICIPAL WASTEWATER EFFLUENTS BY CAPILLARY GAS CHROMATOGRAPHY/REAL-TIME HIGH-RESOLUTION MASS SPECTROMETRY: A PRELIMINARY REPORT,

Burlingame, A. L.

California University,
Berkeley,
Space Sciences Laboratory.

Exotoxicology and Environmental Safety, Vol. 1, No. 1, p 111-150, 1977. 17 fig, 4 tab, 27 ref.

High-resolution gas chromatography, high-resolution mass spectrometry, and elemental composition chromatography identified trace organic compounds in secondary and tertiary municipal effluent and primary petroleum refinery effluent. The municipal waste water samples included: secondary effluent which had been treated by the activated sludge process; tertiary effluent treated with flocculation, sedimentation, filtration, and chlorination; and tertiary effluent also treated with carbon adsorption. Trace organics in the secondary and tertiary effluent were eluted with both 6% and 15% ether in hexane, followed by separation in a column effluent splitter. Samples were analyzed by packed column gas chromatography, capillary column gas chromatography, high-resolution gas chromatography-real-time high-resolution mass spectrometry, and elemental composition chromatography. Secondary effluent contained: di-, tri-, tetra-, and pentachlorobenzenes; tri-, tetra-, and pentachloroanisoles; and various alkylbenzenes. Pentachloroanisole and alkylbenzenes were not removed by tertiary treatment. Analyses of the neutral, phenolic, and acidic fractions of refinery effluent were performed by elemental composition chromatography after oxidation and clarification or after nonaerated stabilization. Trace amounts of complexed hydrocarbons, oxygenated compounds, nitrogen compounds, and sulfur compounds were detected in the neutral fraction.

E176

CHARACTERISTICS OF CALCUTTA SEWAGE,

Nath, B., Mukherjee, D. B., and Das Gupta, S. B.

All India Institute of Hygiene and Public Health,
Calcutta.

Journal of the Institution of Chemists (India), Vol. 49, No. 6, p 279-281, November, 1977. 2 tab, 3 ref.

Pollutant parameters in sewage were monitored in Calcutta, India, over a two-year period in studies to select a treatment process suitable to the waste water characteristics. Total solids, alkalinity as $CaCO_3$, and chloride concentrations were highest during May and June. Temperature ranged over 23.3-31.2 C; the pH averaged 6.75. Other averages were: 1444 mg/liter total solids, 333 mg/liter alkalinity, 275 mg/liter chloride, 154 mg/liter BOD, 411 mg/liter COD, and 33.4 mg/liter total nitrogen. About 64.3-69.4% of the total nitrogen was in free or saline ammonia form; the remainder was found as nitrite or nitrate. All sewage samples lacked dissolved oxygen during the sampling period. Phosphate concentrations ranged over 31.0-50.0 mg/liter; higher nitrogen concentrations were observed during the winter months.

E177

ACTINOMYCETE SCUM PRODUCTION IN ACTIVATED SLUDGE PROCESSES,

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Philadelphia, Pennsylvania,
Department of Environmental Sciences.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 628-634, April, 1978. 7 fig, 11 ref.

Actinomycete scum formation on the surface of activated sludge aeration tanks was analyzed using 94 samples collected from 32 activated sludge plants over a 12-yr period. The actinomycetes were of the genus Nocardia and represented as short, highly branched filamentous colonies; actinomycete scum was formed by the secretion of lipids which collected on air bubbles which then agglomerated on the aeration tank surface as a scum. The scumming in aeration tanks was often found in activated sludge plants treating some dairy wastes. BOD in the effluent from the plants was lower than in other plants without actinomycete scum problems; suspended solids were significantly higher. No correlation was found between actinomycete counts and the food-to-microorganism ratio or the sludge volume index. In the samples analyzed, actinomycete counts were never above 100/mg mixed liquor suspended solids when the mean cell retention time was less than 9 days. All of the plants that had scum problems operated at temperatures above 18 C and mean cell retention times longer than 12 days; high actinomycete counts were not always associated with scumming. The deflocculated or floating sludge caused by actinomycete scumming had poor separating properties and was not considered a form of sludge bulking. Laboratory tests indicated that the scum might be partially dissolved with hexane or acetone.

E178

A SURVEY OF PHOSPHORUS LEVELS IN TREATED MUNICIPAL WASTEWATER,

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Corvallis Environmental Research Laboratory,
Environmental Protection Agency,
Oregon.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 718-722, April, 1978. 2 tab, 10 ref.

Phosphorus and nitrogen levels were measured in samples of treated effluent from 809 waste water treatment facilities which discharge effluent to lakes, reservoirs, or tributaries. The treatment plants were categorized into four groups: 709 not under a phosphate detergent ban and not providing tertiary phosphate removal; 42 New York plants where phosphate detergent bans were imposed half-way through the sampling period; 25 Indiana plants under a phosphate detergent ban; and 33 plants providing tertiary phospate removal but not under detergent bans. The effluent from the group of 709 plants had a median phosphorus concentration of about 6.1 mg/liter and a medium nitrogen level of about 15 mg/liter. Effluents from the New York plants averaged 3.4 mg/liter phosphorus and 13.5 mg/liter nitrogen. The median phosphorus concentration was about 2.7 mg/liter and median nitrogen level about 11.6 mg/liter in the Indiana plants. The plants providing tertiary treatment produced median phosphorus levels of 1.8 mg/liter and nitrogen concentrations of 11.6 mg/liter. The phosphate detergent ban in Indiana accounted for a 50% reduction in the per capita phosphorus load in the effluent when compared to the 709 plants without phosphate restrictions. Activated sludge and stabilization ponds provided greater nitrogen and phosphorus removal than did primary treatment or trickling filtration.

E179

COMPENSATION FOR AN INHERENT ERROR IN THE DETERMINATION OF THE CHEMICAL OXYGEN DEMAND OF SEWAGE,

Stones, T.

Effluent and Water Treatment Journal, Vol. 18, No. 6, p 290-292, June, 1978. 5 tab, 4 ref.

Correction factors were defined for the 0.125 N ferrous ammonium sulfate titration of residual dichromate during the analysis of COD in waste water. Inherent errors in the determination of COD result from: the decomposition of dichromate, added as 25 ml of a 0.25 or 0.125 N potassium dichromate solution; and by temperatures above 130 C induced by sulfuric acid concentrations above 45%. British standard methods recommend a 54.4% acid concentration while American standards advocate a 50.0% sulfuric acid for COD analysis. The 45% acid concentration is reported to result in incomplete oxidation and reduced COD concentrations. The corrections are derived by comparing theoretical and actual titers obtained during COD analysis of glutamic acid solutions. In a reduced scale working model for the determination of COD in waste water, a 10 ml sample of sewage is mixed with 0.5 g mercuric sulfate, and dissolved in 5 ml concentrated sulfuric acid. The sample is then mixed with 20 ml of 0.125 N potassium dichromate and 30 ml of a 0.2% wt/vol solution of silver sulfate in concentrated sulfuric acid; the sample is then heated under reflux for 2 hrs. The cooled aliquot is diluted with 100 ml distilled water and titrated with 0.125 N ferrous ammonium sulfate for excess dichromate titration. The titration corrections are applied to compensate for the thermal decomposition of dichromate.

E180

BIOLOGICAL GROWTH ON ACTIVATED CARBON: AN INVESTIGATION BY SCANNING ELECTRON MICROSCOPY,

Weber, W. J., Jr., Pirbazari, M., and Melson, G. L.

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Department of Environmental and Water Resources
Engineering.

Environmental Science and Technology, Vol. 12, No. 7, p 817-819, July, 1978.
7 fig, 15 ref.

Micrographs depicting the bacterial and bacteriovorous protozoan growth on granular activated carbon from mixed batch and expanded bed continuous flow reactors were obtained with a JOEL JSM-U3 scanning electron microscope. Activated carbon samples from a mixed batch reactor treating raw and coagulated sewage and from a continuous flow reactor treating humic acid were immersed in a 2% paraformaldehyde-2.5% glutaraldehyde solution for 2 hrs to kill the attached organisms. The samples were then treated with 1% OsO4 in 0.1 M sodium phosphate buffer at pH 7.3 to fix the liquid portion of the cell membrane. The specimens were dehydrated in ethanol baths, an ethanol-amylacetate solution, and amylacetate and dried with a critical point dryer. Microorganisms attached to carbon from the mixed batch reactor consisted primarily of stalked protozoans; the spherical ciliates were about 16 microns in size and were firmly attached by their stalks to the carbon surface. Carbon from the expanded bed reactor contained rod-like bacteria about 1.3 microns in length. Bacterial colonies on the surface formed a nonhomogenous slime with a porous matrix.

E181

ANTIBIOTIC RESISTANCE PATTERNS OF FECAL COLIFORMS ISOLATED FROM DOMESTIC SEWAGE BEFORE AND AFTER TREATMENT IN AN AEROBIC LAGOON,

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Department of Microbiology.

Canadian Journal of Microbiology, Vol. 24, No. 7, p 886-888, 1978. 2 tab, 12 ref.

The antibiotic sensitivity of fecal coliforms isolated from raw sewage and aerobic storage lagoon effluent was measured in Taber, Alberta, Canada. The isolated colonies were exposed to antibiotic discs, bearing 10 micrograms of ampicillin, aureomycin, chloromycetin, gentamicin, streptomycin, tetracycline, or 300 micrograms sulfadiazine. The aerobic lagoon reduced fecal coliform counts by about 95%. While most coliform populations in raw sewage exhibiting resistance to single antibiotics were diminished by lagoon treatment, 11.5% were resistant to tetracycline and 0.8% to gentamicin in both raw and treated sewage. Of the fecal coliform populations in the lagoon effluent, 7.7% were resistant to streptomycin, 4.6% to ampicillin, and 18.5% to sulfadiazine. The 3.9% population in the raw sewage resistant to chloromycetin disappeared in the lagoon effluent. About 3.1% of the raw sewage coliforms and 4.6% of the effluent coliforms were resistant to a combination of four antibiotics; 5.4% of the raw sewage population was immune to a combination of five antibiotics. The apparent lack of intercellular transfer of resistance in the sediments of the lagoon effluent was attributed to the low population densities and not to an extrachromosomal R-factor.

E182

RAPID FLAMELESS ATOMIC ABSORPTION ANALYSIS OF THE METALLIC CONTENT OF SEWAGE SLUDGES - II. CHROMIUM, NICKEL AND ZINC,

Stoveland, S., Astruc, M., Perry, R., and Lester, J. N.

Imperial College,
London, England,
Department of Public Health Engineering.

The Science of the Total Environment, Vol. 9, No. 3, p 263-269, 1978. 5 tab, 15 ref.

A flameless atomic absorption spectrophotometric technique detects chromium, nickel, and zinc in homogenized sludge samples. Sludge samples are diluted with 50 parts 1% Analar nitric acid. The sludge samples are then homogenized for 5 min at 8000 rpm and dried at 99 C for 30 sec. For Cr analysis, the sample is ashed at 1,207 C for 30 sec and atomized at 2,660 C for 10 sec; flameless atomic absorption spectrophotometry is performed at 357.9 nm. Trivalent and hexavalent Cr yield identical signals with flameless atomization. For Ni analysis, the diluted sludge sample is ashed at 971 C for 30 sec, atomized at 2,627 C for 10 sec, and measured at 232.0 nm. After a sample has been ashed at 520 C for 60 sec and atomized at 2,231 C for 5 sec, zinc can be measured at 307.6 or 213.9 nm. The latter spectral line provides a detection limit of 0.001 mg/liter and working range of 0.001-0.02 mg/liter; extensive dilution is required for larger zinc concentrations. The 307.8 nm line, with a detection limit of 0.1 mg/liter, is recommended for sewage analysis. Flameless atomic absorption of homogenized sludge yields results comparable to bomb or nitric-sulfuric acid digestion with flame atomic absorption.

E183

CONCERNING THE BEHAVIOR OF MBAS AND BIAS IN A MUNICIPAL SEWAGE TREATMENT PLANT (Ueber das Verhalten von MBAS und BiAS auf einer kommunalen Klaeranlage),

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Department of Chemistry.

GWF-Wasser/Abwasser, Vol. 119, No. 5, p 235-241, May, 1978. 10 fig, 3 tab, 16 ref.

Daily loads and concentrations of anionic surfactants, or methylene blue active substances, and nonionic surfactants, or bismuth active substances, were measured in the raw sewage and the activated sludge effluent of the Busnau-Stuttgart sewage treatment plant in West Germany. Influent methylene blue levels averaged 11.9 mg/liter and bismuth levels about 3.08 mg/liter; effluent concentrations were approximately 0.59 mg/liter methylene blue and 0.28 mg/liter bismuth. The daily surfactant loading on the plant was described by a logarithmic normal distribution. Total phosphorus averaged 14.5 mg/liter in the influent and 11.5 mg/liter in the effluent; COD and BOD levels were 354 mg/liter and 194 mg/liter, respectively, in the influent and 64.0 and 5.9 mg/liter, respectively, in the effluent. Peak loading was found to occur on Monday and Saturday, with lowest concentrations occurring on Sunday. Fluctuations in surfactant loading were reflected in parallel deviations in total phosphorus, COD, and BOD loads. Mean BOD and COD reductions of 96.4% and 81.0%, respectively, correlated to a mean methylene blue removal of 94.4% and a mean bismuth reduction of 91.2%; total phosphorus was reduced by 16.9% in the effluent.

E184

SOURCES AND CHARACTERISTICS OF SOLUBLE ORGANIC NITROGEN IN ACTIVATED-SLUDGE EFFLUENTS,

Partin, G. F.

Dissertation Abstracts International B, Vol. 38, No. 12, p 6106-6107, 1978.

The sources and characteristics of soluble organic nitrogen (SON) in activated sludge effluents and raw sewage were investigated. From 20-50% of the biologically produced SON originates from excreted materials; another 20-50% results from organism decay, while a much smaller percentage is produced by substrate oxidation. About 20-40% of the SON is produced biologically during the activated sludge process. When operated with 6 hours of aeration and 4-10 days of solids retention, the activated sludge can reduce SON by 60-70% and soluble COD by 70-80%. SON concentrations of 0.2-0.8 mg/liter can result from semi-continuous operation; these concentrations increase to 1.5-5.0 mg/liter during start-up and system imbalance. SON consists of about 15-30% nucleic acid and 10% free or combined amino acids. About 50-60% of the effluent SON and soluble COD has a molecular weight below 1,800; higher molecular weights are observed in the excess SON produced during start-up. Activated carbon adsorption reduces SON by about 72% and soluble COD by about 78%. Cationic exchange at pH 2.0 reduced SON by 33-56%; at pH 9.5, anionic exchange reduces SON by about 10-24%.

E185

LARGE EUNICE HARASSII AUDOUIN AND MILNE-EDWARDS FROM A SLUDGE DISPOSAL AREA,

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Menai Bridge, Anglesey, North Wales.

Proceedings of the Royal Irish Academy, Section B: Biological, Geological and Chemical Science, Vol. 77, No. 9, p 175-179, 1977. 3 fig, 8 ref.

Four polychaete specimens, identified as Eunice harassii Audouin and Milne-Edwards, found in Ireland's Dublin Bay where sewage sludge is discharged, were larger and had more branchial filaments than other specimens previously documented. The appearance of Eunice harassii had not been previously recorded in Irish waters. The maximum number of branchial filaments on specimens found in earlier studies had been 15; Eunice specimens collected in Liverpool Bay, Menai Bridge, and museum specimens from the English Channel had up to 26 filaments. The four Dublin Bay annelids had maximum filament numbers of 24, 30, 32, and 34; setiger widths for three of the four specimens were in the 8-10 mm range. The fragmented worms were found in Dublin Bay at a depth of about 30 m in an area receiving about 140,000 wet tons/yr primary sewage sludge; the enrichment of the area was thought to be a primary factor in the large size of the Eunice harassii.

E186
ORGANIC CONTAMINANTS IN WATER,

Effluent and Water Treatment Journal, Vol. 18, No. 7, p 311, July, 1978.

The EPA has retained Battelle Columbus Laboratories in Ohio for a 3-yr $1.5 million survey of contaminants in drinking water and tertiary effluents. The water analysis will focus upon a number of toxic substances, such as 2,3,7,8-tetrachlorodibenzo-p-dioxin and polychlorinated biphenyls. Toxic organic compounds will be identified by gas chromatography-mass spectrometry; a computer will be used to match unidentified spectra with reference sample spectra. An integration of the specific ion current system will be employed to quantify the compounds. Drinking water and tertiary effluent samples from six regional areas in Texas, California, and the District of Columbia will be tested, as well as samples from Miami, Florida; New Orleans, Louisiana; Ottumwa, Iowa; Philadelphia, Pennsylvania; and Seattle, Washington.

E187
WIDER USE OF SEWAGE SLUDGE,

Effluent and Water Treatment Journal, Vol. 18, No. 7, p 311, 313, July, 1978.

England's Water Research Center has developed a technique to evaluate the thickening properties of sewage sludges. A low speed centrifuge accelerates the sludge settling process and simulates the thickener's compressive force. Subjecting a sludge sample in a 10-cm tube to 20 min of gravitational acceleration is equivalent to 3.5 hrs of thickening in a 200-cm deep tank. The technique was developed during investigations into the agricultural application of sewage sludge to plants. To reduce transport costs, it was necessary to increase sewage with 5% solids contents to 12% solids; the thickening analysis was also applied to laboratory studies on anaerobic digestion of sludges. The Center is evaluating the effects of applying three types of undigested sludge and one lagooned sludge to agricultural crops for a 2-yr period.

E188
FLOW AND LOAD VARIATIONS IN TREATMENT PLANT DESIGN,

Young, J. C., Cleasby, J. L., and Baumann, E. R.

Iowa State University,
Ames,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE2, p 289-303, April, 1978. 13 fig, 2 tab, 20 ref.

Waste water flow and loading patterns at the Ames, Iowa, treatment plant were studied as a means of incorporating peak flow and load variations into the design of biological treatment plants. With an increase in population over the last 22 yrs, the organic loading on the plant has increased from an average 4,050 to 6,690 lbs/day BOD and from 3,655 to 7,396 lbs/day suspended solids. Flow rates to the plant peaked during spring months due to infiltration; the peak-month flow rate averaged 135% and the peak-day flow rate was about 191% of the annual flow rate. Peak 8-hr and 4-hr flow rates averaged 229% and 237%, respectively, of the annual average. From these parameters, it was estimated that biological treatment units should be designed to accommodate BOD loads of 1.3 times the average annual load and ammonia loads of 1.25 times the average annual load. Design oxygen supply rates were calculated as a function of the peak daily BOD and ammonia loads plus 50% of the peak 4-hr load rate. Design criteria was also developed for the final clarifiers, the surface settling rate, and the solids load.

E189

ACCUMULATION RATE AND CHARACTERISTICS OF SEPTIC TANK SLUDGE AND SEPTAGE,

Brandes, M.

Applied Science Section, Pollution Control Branch,
Ontario Ministry of the Environment,
Toronto, Canada.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 936-943, May, 1978. 7 tab, 11 ref.

The impact of septic tank capacity and waste water strength on the accumulation rate and the chemical and biological sludge characteristics was evaluated in three septic tanks with different capacities and influent volumes over a 2-yr period. The chemical and bacteriological properties of the sludge and septage were dependent upon the strength of the waste water and the detention time in the tank. The 3,410 liter tank, treating toilet wastes, had a detention time of 9.7 days; the 4,590 liter tank, treating additional bathroom and kitchen wastes, had a detention time of 2.4 days; and the 8,980 liter tank, treating bathroom, kitchen, and laundry wastes, maintained effluent for 1.9 days. Septage was found to accumulate in the tanks at a rate of 200 liters/capita/yr. Longer detention times enhanced decomposition of organic matter and solids removal. Permissible time intervals between cleanings were calculated as 8.08 yrs for the small tank, 2.89 yrs for the medium tank, and 1.44 yrs for the large tank; health regulations required that the small size tank be cleaned every 4.2 yrs.

E190
BIOCHEMICAL OXYGEN DEMAND PROGRESSION IN MIXED SUBSTRATES,

Parisod, J. P., Schroeder, E. D.

California University,
Davis,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1827-1834, July, 1978. 6 fig, 4 tab, 13 ref.

The kinetics and the plateau BOD values for mixed substrate systems were analyzed with glucose, glutamic acid, succinate acid, and sorbitol and the existence of stoichiometric end points for substrate conversion reactions was investigated. Plateau BOD values were obtained for individual and mixtures of soluble substrates seeded with bacteria from primary sedimentation tank effluent or from activated sludge reactors; a Gilson differential respirometer was employed to measure oxygen uptake. The net cell growth in the substrates was calculated by subtracting the initial cell mass concentration from the plateau cell mass concentration. Single substrate plateau values obtained in these experiments correlated closely with previously reported values. In 34 mixed substrate plateau tests, the maximum variation between predicted and actual plateau values was 10.1%; the standard deviation was 4.0%. The study concluded that the calculation of ultimate BOD from the sum of the plateau BOD and the theoretical BOD of the cells produced up to the plateau was a feasible and valid technique.

E191
BIOASSAYS-PROCEDURES AND RESULTS,

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Research Triangle Park, North Carolina.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1852-1868, July, 1978, 179 ref.

Literature on bioassay procedures and their applications to a variety of aquatic flora and fauna was reviewed. The design and interpretation of bioassay testing has been applied to individual chemicals and metals in laboraotory procedures; in-depth studies have examined the impact of naturally occurring complex chemical compounds on bioindicators. Experimental equipment has been designed to closely simulate conditions in water bodies and soils; structures have been improved to provide realistic dosing procedures, to maintain proper oxygen concentrations, to quantify microbial populations, and to record patterns of movement. The results of bioassay procedures were reviewed for microorganisms, algae, invertebrates, and fish; results of comparative testing with several trophic levels and the effect of the health status of the test organisms on the results of bioassay interpretations were also examined.

E192

A NOMOGRAM FOR THE DETERMINATION OF AMMONIA IN WASTEWATER BY A KNOWN ADDITION TECHNIQUE,

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Applied Chemistry Laboratories,
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Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1869-1870, July, 1978. 4 ref.

A nomogram incorporating a known addition technique is presented for calculating the concentration of NH3-N in waste water. The technique is designed to compensate for random drifts in the calibration lines of an ammonia gas sensing electrode. A 1,000 mg/liter NH3-N solution is prepared by adding 3.819 g of NH4Cl to one liter of water, followed by dilutions to 1, 5, 10, 25, 50, and 100 mg/liter. To a 100 ml sample is added 1 ml 10M NaOH; the initial electrode potential is then calculated as a function of the electrode slope and the solution concentration. The Nernstian slope is calculated from a semi-log plot of the millivolts in relation to a series of standard NH3-N solutions. A 2.0 ml sample of a 1,000 mg/liter NH3-N solution is added to the sample and the new equilibrium potential of the electrode is calculated to provide the change in electrode potential. The decrease in potential is then calculated as a function of the electrode slope and the various solution concentrations and volume. The nomogram is developed by aligning the Nernstian slope with the decrease in electrode potential; the concentration of NH3-N is then calculated by extrapolating the line to the intersection with the NH3-N concentration axis.

E193

DIRECT ANALYTICAL PROCEDURE FOR DETERMINATION OF VOLATILE ORGANIC ACIDS IN RAW MUNICIPAL WASTEWATER,

Narkis, N., and Henfeld-Furie, S.

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Technion City, Haifa,
Environmental Engineering Laboratories.

Water Research, Vol. 12, No. 7, p 437-446, 1978. 15 fig, 3 tab, 22 ref.

A technique for analyzing volatile organic acids in raw or chemically treated sewage permits direct injection of the sewage sample into a gas chromatograph without extensive pretreatment. Less than 1 g of crystallized metaphosphoric acid is added to a 10 ml sample of raw sewage to adjust the pH to 2-3. The mixture is then centrifuged at 14,000 rpm for 20 min at 5 C to remove suspended solids and proteins; the sample is injected directly into a gas chromatograph equipped with a hydrogen flame ionization detector. An 8 ft glass column with a 0.125 inch diameter is packed with 60-80 mesh Chromosorb W which has been washed with phosphoric acid and coated with 20% Carbowax 20 M dissolved in chloroform; the packing is washed again after vacuum drying with 3% H_3PO_4. Acetic and propionic acid analysis requires 5-10 microliter samples; 20-40 microliter samples are used for analysis of butyric, isovaleric, valeric, and hexanoic acids. The appearance of volatile acids after 4-7 min of retention follows the order: acetic, propionic, isobutyric, butyric, isovaleric, valeric, and hexanoic acid; formic acid is not detectable by flame ionization. The gas chromatography direct injection technique can detect and quantify 70.0-97.5% of the volatile acids identified acccording to standard methods.

E194

METHODS FOR CHECKING THE OPERATION OF ACTIVATED-SLUDGE WASTEWATER TREATMENT PLANTS AND FOR DETERMINING DESIGN CRITERIA FOR NEW TREATMENT FACILITIES
(Modszerek eleveniszapos szennyviztisztito telepek uzemenek ellenorzesere, uj telepek tervezesi adatainak a meghatarozasara),

Fleps, W., Pal, T., and Szilagyi, M.

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Budapest, Hungary.

Hidrologiai Kozlony, No. 4, p 166-173, 1978. 1 fig, 5 tab, 5 ref.

A flow-through respirometer measured the impact of increased aeration basin retention time, increased activated sludge concentration, and effluent suspended solids concentration on the COD removal efficiency of a Hungarian waste water treatment plant. The respirometer contained a flow-through reactor and settling tank, a gas scrubbing flask, an oxygen burette, feed valves, a graduated cylinder for collecting treated effluent, and a peristaltic pump for introducing raw sewage from the holding tank into the reactor. When the retention time in the aeration basin was increased from 2 to 4 hrs, COD removal only increased from 61.6 to 62.1%; COD removal decreased from 62.6 to 50.0% and unit oxygen demand increased from 58 to 70 mg/liter when the activated sludge concentration increased from 3.0 to 5.0 g/liter. Effluent suspended solids levels averaged 43 mg/liter over a 24 hr period; this high concentration, as well as high diurnal COD concentrations in industrial wastes discharged to the plant, were considered the causes of poor COD removal efficiency. Respirometer, pilot plant, and full-scale tests indicated that doubling the aeration basin retention time would reduce COD by 76-78% and suspended solids by 89-90%.

E195

THE OCCURRENCE OF AEROMONADS IN ACTIVATED SLUDGE: ISOLATION OF AEROMONAS SOBRIA AND ITS POSSIBLE CONFUSION WITH ESCHERICHIA COLI,

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Stockholm, Sweden.

Journal of Applied Bacteriology, Vol. 44, No. 2, p 259-264, 1978. 1 tab, 26 ref.

Strains of Aeromonas sobria, isolated from activated sludge, paper mill effluent, and biologically-treated food processing effluent, exhibited characteristics very similar to E. coli when analyzed according to standard methods. Between 100,000 and 10,000,000 aeromonads/g wet weight were isolated on Endo Agar, Tergitol-7 Agar, galactitol peptone agar, Shotts and Rimler medium, and analine blue agar. All of the isolated populations produced acid in stabs of triple sugar iron medium but demonstrated weak or negligible oxidase activity in freshly isolated strains. A. sobria produced gas more readily from lactose and formed metallic colonies on Endo and EMB agars; A. hydrophila more readily hydrolyzed aesculin, formed acid from arabinose and salicin, and exhibited aerobic growth in arabinose, L-histidine, and L-arginine. None of the isolates produced gas from lactose in EC medium at 44.5 C. About 95% of the strains were resistant to ampicillin and sensitive to gentamycin; all were resistant to penicillin and sensitive to tetracycline and chloramphenicol. None of the strains exhibited nitrogenase activity comparable to the nitrogen-fixing capacity of Enterobacteriaceae. Other characteristics distinguishing A. sobria strains from E. coli included positive DNase, lipase, gelatinase, and arginine decarboxylase activities. The strains are unable to produce acid from xylose and arabinose or grow in L-glutamate; about 67% of all strains were beta-hemolytic.

E196

DEVELOPMENT OF QUANTITATIVE METHODS FOR THE DETECTION OF ENTEROVIRUSES IN SEWAGE SLUDGES DURING ACTIVATION AND FOLLOWING LAND DISPOSAL,

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Department of Virology and Epidemiology.

Applied and Environmental Microbiology, Vol. 36, No. 1, p 81-89, July, 1978. 3 fig, 9 tab, 16 ref.

Enteroviruses were eluted from sewage sludge by: suspension of the solids in 0.05 M glycine buffer at pH 11.5; magnetic stirring for 30 sec; centrifugation; adjustment to pH 3.5 by the addition of 0.05 M glycine buffer at pH 2.0 to form organic flocs; filtration through 3.0, 0.45, and 0.25 micron filters;

and elution for bioassay. The described procedure recovered about 80% of poliovirus type 1, 68% of echovirus type 7, and 75% of coxsackievirus B3 from seeded activated sludge. The technique required about 3 hrs to complete and recovered more viruses than elution with 3% beef extract and sonification. Analysis of activated sludge after land application concluded that a linear semilogarithmic relationship exists between viral inactivation and duration on land. After 7 days of drying in the field, 0.5-3.0% of the viruses were recovered from the sludge; no viruses were apparent in the sludge 3 mos after land application. Sludge solids content increased up to 30 days, levelled at about 65% solids, and subsequently decreased; a direct correlation was observed between moisture loss in the sludge and viral inactivation.

E197
A MORE ECONOMICAL METHOD FOR THE DETERMINATION OF CHEMICAL OXYGEN DEMAND,

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Burlington, Ontario.

Water Pollution Control, Vol. 116, No. 5, p 25-29, May-June, 1978. 1 fig, 5 tab, 9 ref.

An alternative technique for COD analysis of waste water, employing spectrophotometric measurement, utilizes smaller sample and reagent volumes. A 10 ml waste water sample, standard, or blank solution is placed in a screw cap culture tube which is of a size suitable for direct placement in the adapter of the spectrometer. The sample is mixed with 6 ml of a digestion solution; the digestion solution is prepared by mixing 167 ml concentrated sulfuric acid, 500 ml distilled water, 17.0 g mercuric sulfate, and 10.216 g potassium dichromate; cooling the mixture; and diluting it to 1.00 liter. A 14 ml aliquot of catalyst solution, prepared by mixing 22 g of reagent grade silver sulfate in a 19.8 kg bottle of concentrated sulfuric acid, is added to the sample. The solution is digested for two hours with the teflon-lined bakelite cap closed at 150 C in a forced-air oven. After the aliquot has cooled, absorbance is measured at 600 nm; the blank is adjusted to 100% transmittance and the sample optical densities are plotted against COD to form a calibration curve. Values of tests using the described procedure have been slightly higher than those obtained by standard COD techniques; this difference is attributed to more complete digestion and retention of volatile matter in the culture tube. The detection limit of the test is reported to be double the optical density variation at the blank level; samples containing more than 1,000 mg/liter COD must be diluted before testing.

E198
REGULAR TESTING CAN CONTROL HYDROGEN SULFIDE,

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San Jose, California.

Water and Sewage Works, Vol. 125, No. 7, p 68-70, July, 1978. 3 fig, 1 tab.

Procedures to quantify and control hydrogen sulfide in waste water can reduce the gas's potential toxic effect on treatment plant workers and alleviate sewer corrosion from sulfuric acid generation. Monitoring the pH of the waste water is important in calculating the amount of dissolved sulfide present as hydrogen sulfide, associated with the odor and corrosion problems, or as hydrosulfide ions; hydrogen sulfide predominates in acidic wastes and equals the quantity of hydrosulfide ions at pH 7. The methylene blue colorimetric test, with a detection limit of 20 mg sulfide/liter, has several variations: the titrimetric iodine test for oxidizing sulfides to sulfur; the LaMitte-Pomeroy test with dual test tube analysis; the Hach Alka-Seltzer technique which effervesces hydrogen sulfide onto a chemically treated disc; and gas detector tubes. A T-I-Y Kit developed by FMC Corp. can be used for analysis when hydrogen peroxide is used to control hydrogen sulfide. Hydrogen peroxide may be detected with titanium sulfate or test strips. A laboratory analysis of three waste water samples, untreated, treated with a small quantity of H2O2, and treated with a larger H2O2 dose, provides data on the optimum H2O2 dosage to control sulfide in waste water. From this information, field tests can be conducted at problem sites to determine specific treatment needs.

E199
ANTIBIOTIC RESISTANCE PATTERN OF SALMONELLA WELTEVERDEN STRAINS ISOLATED FROM MAN, ANIMALS, SEWAGE AND WATER,

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College of Veterinary Medicine.

Indian Journal of Medical Research, Vol. 67, p 212-216, February, 1978. 2 tab, 9 ref.

Strains of Salmonella welteverden isolated from humans, animals, sewage, and water were examined for resistance or sensitivity to antibiotics. Of the 127 strains isolated, all were completely resistant to bacitracin and erythromycin. Strains isolated from humans exhibited resistance to eight other antibiotics, including: sulfathiozole, viomycin, polymyxin B, nalidixic acid, tetracycline, oxytetracycline, chlortetracycline, and kanamycin; human isolates were the only strains resistant to the three latter antibiotics. The higher resistance of human strains was attributed to the frequent medical use of antibiotics.

Animal strains were resistant to four antibiotics while sewage isolated strains were resistant to three. Minimum inhibitory concentration (MIC) levels of 60 strains against polymyxin B sulfate, tetracycline, and chloramphenicol were high for human strains exposed to tetracycline and chloramphenicol and high for sewage strains in contact with polymyxin B sulfate. Low MIC level sensitive strains from humans were recorded for polymyxin B and tetracycline. Low MIC level sensitivity to chloramphenicol was absent in human strains but present in animal and sewage strains.

E200

COMPUTER CONTROL SYSTEM FOR WATER AND WASTEWATER TREATMENT PLANTS,

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Hitachi, Limited,
Tokyo, Japan.

Hitachi Review, Vol. 27, No. 3, p 146-152, 1978. 10 fig, 7 ref.

Hitachi, Ltd., of Japan has developed the AQUAMAX-80 computer control series and AQUADIC, the supervisory control computer subsystem, for use in water and waste water treatment plants. The AQUAMAX-80 series permits shifts from centralized to distributed systems, from hardware to software systems, and from simple to total or optimum control; it provides continued localized control in the event of supervisory system shut-down. Three models are available in the series. The A analog control model for small plants has a graphic panel which provides cathode-ray tube (CRT) display for plant monitoring and data logging. The C model offers microcomputerized control, light emitting diode display (LED), CRT, and a high-speed telemeter and telecontrol system (signal transmission unit). The computerized supervisory F system provides CRT and LED display, high-speed data transmission, and optimum operation and prediction controls. All series are equipped with Hitachi's telemetry system, data concentrating boards, and motor control centers. The AQUADIC system provides: a data base for analog, fault, and other information; standard programs for water and waste water treatment plants; analog, digital, and pulse input; digital and analog output; CRT formats; sequential fill-in-the-form logging; and an automatic reports generator. The color CRT and special keyboard provide the operator-machine interface for displaying equipment, instrument, and piping details. A typical computerized dissolved oxygen control system designed for an activated sludge plant provides feedback and feed forward control, nonlinear compensation for valve position-air flow rate, and feedback valve position compensation.

E201

TWO-TEMPERATURE MEMBRANE FILTER METHOD FOR ENUMERATION OF FECAL COLIFORM BACTERIA FROM CHLORINATED EFFLUENTS,

Green, B. L.

Dissertation Abstracts International B, Vol. 39, No. 1, p 80, 1978.

The incubation procedure required for the membrane filtration enumeration of fecal coliform bacteria in chlorinated effluents was modified to permit more accurate analysis. Incubation of chlorinated effluent samples at 44.5 C prior to standard membrane filter enumeration of coliforms was found to critically affect the recovery of sublethally injured coliforms. Chlorinated primary and secondary effluents were preincubated at 35 C for 5 hrs, followed by incubation for about 18 hrs at 44.5 C, prior to membrane filtration of the effluents for coliform quantification. Results of the modified and standard methods were compared to those obtained by multiple-tube most probable number (MPN) procedures; the standard membrane filter technique recovered only 15% of the coliforms obtained by the MPN procedure. The modified incubation technique yielded 68% of the fecal coliforms recovered by the MPN procedure. Correlation of results obtained from the modified technique and the MPN procedure was highest in tests with secondary effluents.

E202

DETERMINATION OF ORGANOSILICONE IN SEWAGE SLUDGE BY ATOMIC ABSORPTION SPECTROMETRY,

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Buseki Kagaku, Vol. 27, No. 6, p 343-347, 1978. 4 fig, 6 tab, 6 ref.

Organosilicone was separated from sewage sludge by solvent extraction, dehydration, and activated carbon filtration before analysis by atomic absorption spectrometry. A 10-20 g sample of sludge was neutralized to pH 6-7 and placed in an extraction apparatus with 100-150 ml of toluene. The sludge was azeotropically dehydrated; the organosilicone was extracted in 70-100 ml of toluene. After vacuum evaporation of the toluene, the organosilicone-bearing residue was dissolved in methyl isobutyl ketone; the solution was filtered through an activated carbon column and concentrated to 20 ml. The organosilicone concentration was determined by atomic absorption spectrometry at 251.6 nm; the oil was primarily in the form of dimethylpolysiloxane. The extraction process recovered about 88% of the organosilicone at a variance coefficient of 12%. The technique was considered more practical than liquid-liquid extraction by a separation funnel or extraction by a Soxleht unit; results of the atomic absorption spectrometry analysis were comparable to those of proton nuclear magnetic resonance or gel permeation chromatography.

E203

TOXICITY-TEST ON FISH CARASSIUS AURATUS IN WATERS AND SEWAGES CONTAINING PHENOL, TREATED WITH NACLO OR WITH CLO2 (IL TEST DI ITTIOTOSSICITA' SU ACQUE E LIQUAMI DEPURATI CON IPOCLORITO E BIOSSIDO DI CLORO, IN PRESENZA DI FENOLO),

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Department of Hygiene and Science.

Igiene Moderna, Vol. 71, No. 1, p 86-116, 1978. 8 fig, 3 tab, 27 ref.

Goldfish (Carassius auratus) were used in 50% median mortality (TLM50) tests performed on phenolated sewage and potable water disinfected with chlorine dioxide or sodium hypochlorite. Samples of phenol-bearing spring, mineral, and tap water were treated with 40 ppm of ClO2 or NaClO for a contact time of 30 min; oxidized waste water, containing 30-70 ppm BOD, 60-95 ppm COD, and 400,000-700,000 coliforms/100 ml, and graywater having 95-280 ppm BOD, 280-400 ppm COD, and 8,000,000-50,000,000 coliforms/100 ml were similarly treated. The potable and sewage waters acquired a 'secondary induced toxicity' after treatment with either disinfectant; phenolated potable water was more toxic than sewage wastes after treatment. The greater toxicity of the disinfected potable waters was attributed to the lack of organic matter, especially fecal coliforms, to consume the chlorinated phenolic compounds. The TLM50 for goldfish sustained in mineral, spring, and tap water treated with NaClO ranged over 1.22-2.92 hrs; in water treated with ClO2, the TLM50 covered 2.85-4.85 hrs. The TLM50 of oxidized waste water was 7.35 hrs after NaClO treatment and 9.05 hrs after ClO2 disinfection; graywater yield TLM50 values of 7.16 hrs and 8.46 hrs after treatment with NaClO and ClO2, respectively. Graywater was more toxic to fish before disinfection; untreated phenolated tap water was more toxic to fish than the other potable waters tested.

E204

SIGN-OF-CHARGE OF SPECIES OF CU, CD AND ZN EXTRACTED FROM SEWAGE SLUDGE, AND EFFECT OF PLANTS,

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United States Department of Agriculture,
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Plant and Soil, Vol. 49, No. 1, p 117-125, 1978. 2 fig, 2 tab, 18 ref.

Laboratory studies measured the sign of charge and the concentration of Cu, Cd, and Zn leached from moist or air-dried 5-yr-old sewage sludge passed through columns bearing cationic, anionic, or mixed resins; the sewage sludge had been obtained from the Back River waste water treatment plant in Baltimore, Maryland. The sludge had an initial moisture content of 38.4% which was reduced to 1.9% by air drying. Aliquots of sludge, extracted by equilibration, were adjusted to pH 3.2, 5.2, and 6.6 before filtration through the resins. For air-dried sludge, the Cd extract yielded 87% cationic species; the Cu extract contained 16% cationic and 72% amphoteric species. Moist storage extracts contained 83% amphoteric Cd, 50% cationic Cu, and 30% amphoteric Cu. Increasing the pH of the extracts caused an increase in neutral and anionic Cu species. Zn extracts, regardless of storage conditions, yielded 84-92% cationic species. The Cu uptake from sludge extracts by plants was analyzed by growing soybean seedlings for 48 hrs in aqueous extracts of Cu-enriched sludge. Extracts sampled after the growth period demonstrated that 68% of the amphoteric, 55% of cationic, 83% of anionic, and 100% of neutral Cu species remained in the extract.

E205

H2-PRODUCING BACTERIA IN DIGESTING SEWAGE SLUDGE ISOLATED ON SIMPLE, DEFINED MEDIA,

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Applied and Environmental Microbiology, Vol. 36, No. 2, p 394-395, August, 1978. 2 tab, 10 ref.

Five genera of H2-producing Enterobacteriaceae were isolated from digested sewage sludge on a modified anaerobic basal salts medium, supplemented with various carbohydrate substrates. The basal salts medium received additions of 0.0000001 M sodium selenite, 4 mg/liter ferrous chloride, a vitamin mixture, 1.5% wt/vol agar, and one of the test substrates. The supplemental substrates included: glucose, fructose, sucrose, maltose, cellobiose, glutamate, histidine, glycine, serine, threonine, stearic and oleic acids, phenol, nicotine, tryptophan, benzoate, and olive oil. Glucose yielded the highest number of H2-producing isolates; carbohydrate substrates produced more H2-producing bacteria than non-carbohydrate media. About 69% of the isolates recovered on glucose were H2-producing species; 58% of the isolated Enterobacteriaceae were identified as Citrobacter, 28% as Enterobacter, 0.3% as Escherichia, and 13% as two unidentified genera. Of all the H2-generating bacteria produced, 85% were isolated on glucose and consisted of 65% Citrobacter and 25% Enterobacter; about 2% of the isolates were found on non-carbohydrate media. The average H2-producing bacterial count in digested sewage sludge was about 14,000,000/ml sludge; it was concluded that H2-producing Enterobacteriaceae contribute in some way to the eventual production of methane.

F001

ASSESSMENT OF MATHEMATICAL MODELS FOR STORM AND COMBINED SEWER MANAGEMENT, APPENDIX F: SELECTED COMPUTER INPUT AND OUTPUT,

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Water and Land Resources Department,
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1976. 387 p. Technical Report EPA-600/2-76-175b.

Input data and selected output are presented as part of a general evaluation of storm water management models. Hypothetical catchments and pipe systems were used in simulations. Storm water management models which are considered include: Battelle Urban Waste Water Management Model, Chicago Flow Simulation Program, Dorsch Consult Hydrograph-Volume, Environmental Protection Agency Storm Water Management Model (SWMM), Massachusetts Institute of Technology Urban Watershed Model, SOGREAH Looped Sewer Model, and Water Resources Engineers Storm Water Management Model.

F002

THE ACTIVATED SLUDGE PROCESS, PART II--DYNAMIC BEHAVIOUR,

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Water Research Commission of South Africa,
Water Resources and Public Health Engineering.

Water SA, Vol. 3, No. 1, p 17-50, January, 1977. 48 fig, 10 tab, 10 ref, 1 append.

A model to describe the behavior of the activated sludge process under dynamic conditions for both carbonaceous and nitrogen degradation is presented. Aspects of carbonaceous degradation include influent COD fractions, biodegradable COD removal, synthesis of cell mass, endogenous respiration, and carbonaceous oxygen demand. Various aspects of nitrogen removal are discussed, including influent TKN fractions, nitrogen requirements for sludge, and the storage of nitrogen. The mathematical model includes basic differential equations for sludge generation, COD utilization, and nitrification. Equations are presented for the general form of the mass balance equation, the biodegradable COD in the reactor liquid, unbiodegradable COD in the reactor, active mass concentration in the reactor, the stored COD (as VSS) accumulated in the sludge, inert material accumulating through endogenous residue, inert material accumulating from the influent, rate of change of total mass (MLVSS), slowly biodegradable TKN, unbiodegradable nitrogen, immediately available nitrogen, nitrates in the reactor liquid, and oxygen utilization. The predictive abilities of the mathematical model were tested against experimental data. Activated sludge process performance is evaluated with respect to sinusoidal and square-varying loading conditions. A design example is presented for a completely-mixed activated sludge plant with a flow of 10 M liters/day, sludge age of 20 days, peak COD mass flow of 1.8 times the average COD mass flow, and sinusoidal loading conditions.

F003

FUNCTIONAL DESIGN OF ACTIVATED SLUDGE PROCESSES,

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Department of Bioenvironmental Engineering.

Water and Sewage Works, Vol. 124, No. 9, p 76-81, September, 1977. 4 fig, 2 tab, 9 ref.

Mathematical models for the functional design of activated sludge processes which include design equations based on simultaneous solution of mass balances and equations for direct solution of tank volume are examined. Equations for the mass rate of change in biomass concentration and the effluent substrate concentration are presented. The reaction tank volume is derived as a function of net specific growth rate. Expressions are presented for the recycle flow ratio and the biological solids concentration in the aeration tank. A materials balance for biological solids around the clarifier at steady state conditions is used to provide an expression for excess sludge production. The model is illustrated with a numerical example at the following design conditions: BOD of primary effluent (275 mg/liter), flow rate (10 mgd), required effluent BOD (30 mg/liter), and required suspended solids (30 mg/liter). Use of the model entails: collection of data to characterize the concentration of soluble substrate in the influent; characterization of biomass by determining the saturation constant, maximum specific growth rate, true sludge or cell yield, and the maintenance energy; the determination of the required net growth rate, the selection of recycle flow ratios to give the required concentration of soluble substrate in effluent; calculation of biological solids in the aeration tank; and determination of aeration tank volume, excess sludge production, and metabolic oxygen requirements.

F004
KINETICS AND STOICHIOMETRY OF COMPLETELY MIXED ACTIVATED SLUDGE,

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Journal Water Pollution Control Federation, Vol. 49, No. 9, p 1968-1975, September, 1977. 6 fig, 1 tab, 24 ref.

Microbiological principles, materials balance equations, and the stoichiometric composition of waste water are examined with respect to the completely mixed activated sludge process. Mathematical equations for microbial growth kinetics are derived. Mathematical relationships which describe bacterial growth and substrate utilization are developed from a series of materials balance equations. Parameters defined include: the yield coefficient, the mean cell residence time, the rate of substrate utilization per unit weight of microorganisms, and the food:microorganism ratio. An example problem is calculated according to the described relationships for industrial waste water with a flow rate of 1 mgd and a temperature of 20 C which is treated in a completely mixed activated sludge process. Effluent waste concentration, treatment efficiency, aeration basin volatile suspended solids, waste sludge production, and the food:microorganism ratio are plotted against the mean cell residence time.

F005
SECONDARY SEWAGE TREATMENT VERSUS OCEAN OUTFALLS: AN ASSESSMENT,

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Earth Sciences Department.

Science, Vol. 197, No. 4308, p 1056-1060, September, 1977. 1 fig, 1 tab, 27 ref.

Questions have been posed on the relative cost-effectiveness and environmental effects of ocean outfall dumping as an alternative to secondary sewage treatment. The direct oxygen demand of waste materials and the indirect oxygen demand associated with eutrophication are compared for untreated and secondary effluents. The assimilation characteristics of rivers, estuaries, and coastal waters are defined in terms of volume, dilution, reaction rate phenomena, and retention or residence time in a steady state model. A mathematical model for waste biochemical oxidation is derived to calculate the waste dissolved oxygen deficit in terms of the combined waste discharge oxygen demand, volume, retention time, the waste biochemical oxygen demand decay coefficient, and the time from the discharge. An index for estimating the effects of alterations in waste loading, outfall location, or other environmental factors within the system is presented. A nutrient-limited model for estimating the eutrophication potential in terms of nitrogen waste loading or the potential utilization of the oxygen in waste nutrients by phytoplankton is presented. The phytoplankton dissolved oxygen deficit for bottom waters is derived in terms of oxidation utilization rate, volume, retention time, percentage of phytoplankton which decays in the photic zone, and volume of bottom waters with respect to total volume. Ocean outfalls are suggested as eliminating the eutrophication potential of inorganic nutrients present in secondary-treated effluent.

F006
A MODEL FOR MULTI-PERIOD REGIONAL WASTEWATER PLANNING,

Chiang, C. H.

Dissertation Abstracts International B, Vol. 38, No. 2, p 861, August, 1977.

A method for determining the location, timing, and scale of regional waste water treatment plants, sewers, and pumping stations with a heuristic algorithm composed of several subprograms is presented. The algorithm is capable of producing marginal cost analyses, examining tradeoffs between economies of scale in treatment and waste water conveyance, accounting for existing facilities, and considering plant capacity. Basically an iterative procedure, the algorithm can be used to provide fast, possibly, least-cost solutions to several types of waste water planning problems.

F007
OPTIMIZATION OF A REGIONAL WATER RESOURCE QUALITY MANAGEMENT SYSTEM,

Vasconcelos, J. J.

Dissertation Abstracts International B, Vol. 38, No. 2, p 863, August, 1977.

A mathematical model to optimize design and minimize total costs for a regional water supply-waste water treatment management system is presented. The Fresno groundwater basin in the San Joaquin Valley in California was used in a simulation of an integrated water system with five sources of water for 22 water demands. Declining groundwater levels and increasing concentrations of total dissolved solids and nitrates in groundwater are the major water resource problems in the area. An iterative algorithm which included a linear programming optimization model, a groundwater quantity and quality model, and a data processing-costing program was used to analyze four management alternatives which failed to meet problem constraints.

F008

LOW-TEMPERATURE ORGANIC REMOVAL AND DENITRIFICATION IN ACTIVATED CARBON COLUMNS,

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Journal Water Pollution Control Federation, Vol. 49, No. 10, p 2107-2117, October, 1977. 14 fig, 6 tab, 17 ref.

Results of parallel pilot studies at 5 and 25 C on low-temperature organic removal and denitrification in activated carbon columns are presented, with special emphasis on the monitoring of microbial life in activated carbon columns and the mathematical modelling of these columns in the presence of biooxidation. A series of equations are presented for the modelling of fixed-bed adsorbers in the presence of bacterial activity. Results of pilot studies at the Dundas Water Pollution Control Center indicated that physical-chemical treatment with granular activated carbon columns was capable of delivering high quality effluents at both temperatures examined and that microbial degradation enhanced the adsorptive capacities of the carbon columns. Dentrification was observed in the inside aerobic beds, and anaerobic bioactivity was attributed to localized flow conditions in pockets within the columns. The higher treatment efficiency at 25 C was attributed to the greater proliferation of bacterial life in the column at higher temperatures. Studies on bacterial densities indicated that concentrations were similar to that of mixed liquor in an activated sludge plant. Denitrification rates were increased by at least 25% with the addition of organic substrate in studies with methanol addition in plastic media and GAC fluidized beds. The study concluded that the removal of organics by activated carbon was a biological rather than a physico-chemical phenomenon and that bacterial action did, in fact, prolong the life of the carbon bed.

F009

OPTIMAL CONTROL OF SEWAGE AND RAIN PUMPS BASED ON INFLUENT FLOW PREDICTION,

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Hitachi Review, Vol. 26, No. 7, p 235-240, 1977. 6 fig, 2 tab, 6 ref.

Pumping stations servicing combined sewer lines are subjected to varying influent flow rates during wet and dry weather conditions and in situations where a diurnal distribution in sewage flow occurs. When flow rates of influent to the pumping station can be predicted, pump start-up and operation can be controlled to raise treatment efficiency, minimize energy consumption, and prevent combined sewer overflows. The mathematical models which are presented include an influent prediction model and a scheduling model for quasi-optimum pump operation. The first model utilizes a multiple regression analysis technique to predict influent flows up to 1 hr in advance on the basis of stored volume in the sewer, calculated from sewer line sizes and suction well water level, pumping rate, and rainfall data. The scheduling model or Quasi-optimum Routing System (QRS) is based on the variation of pumping rate through control of the number of pumps in operation with respect to stored volumes and cumulative curves for pumping rate, sewer line capacity, and influent flow rate over a given time period. The QRS technique utilizes a heuristic algorithm to search for a pump scheduling route which minimizes start-stop frequency. The algorithm can then be used in evaluation functions for the total number of pump switchings, energy consumption, variation of pumping rate, operating time of a specified pump, and energy consumption per pumping rate.

F010

HEURISTIC ALGORITHM FOR WASTEWATER PLANNING,

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Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 863-876, October, 1977. 6 fig, 3 tab, 18 ref.

Waste water treatment costs may be reduced and treatment efficiencies increased by regional waste water planning which considers waste water sources, treatment plant sites, sewer systems, and associated costs for multi-purpose treatment facilities. The mathematical model which is presented is designed to evaluate and compare construction costs for treatment facilities and sewage systems with respect to temporal and spatial considerations. The first subprogram encountered in the algorithm is START in which the user proposes construction of plants and lines for the region in each time period and for given locations. STAGE is used to examine costs for combining two or more plants at a given time period of construction with respect to plant scale economics and costs of waste water conveyance. STAGE incorporates several additional routines in decision making: BUMP to determine deficiencies in START input; DROP and ADD to compare costs for construction, expansion, and connection of individual plants in the region; ROUTE to insure that waste water treatment routes are cost-efficient; and SHIFT to insure that treatment plants in the final solution are constructed at the best locations. MERGE is then used to determine whether cost advantages are available in construction of plants and conveyance structures within a single or over several time periods. The STAGE and MERGE subprograms are repeated until no further cost reductions can be realized and a final solution is reached. The upper Connecticut Valley region of Vermont and New Hampshire and the upper Neshaminy Creek basin in Pennsylvania are used in examples of the use of the heuristic algorithm.

F011
DISPERSION OF BUOYANT WASTE WATER DISCHARGED FROM OUTFALL DIFFUSERS OF FINITE LENGTH,

Roberts, P. J. W.

Dissertation Abstracts International B, Vol. 38, No. 4, p 1818-1819, 1977.

Laboratory experiments were used to examine the three-dimensional flow field produced by a line plume analogous to the dispersion of buoyant waste water released from line diffusers in ocean outfalls. Results indicated that the minimum surface dilution was independent of the diffuser length:water depth ratio (L/H) and the Reynold's number (Re) from 1,190 to 12,900. Dilutions were related to a type of Froude number (F) equal to the ratio of the cube of the current velocity (u) to the buoyancy flux per unit length (b). Dilutions were independent of current velocity and current direction for $F<0.1$ and proportional to current velocity for $F>0.1$ when the current direction was perpendicular to the diffuser. At $0.1<F<100$ the development of a vertically stable density profile resulted in dilution which was approximately 60% of that expected under conditions of uniform mixing. Horizontal spreading of the waste field was attributed to buoyancy rather than to ambient turbulence. Initial surface plume spreading was linear and was not affected by L/H and Re for 3.7 L/H 15 and 2,900 L/H 13,000. The plume spreading rate was observed to decrease beyond the initial linear zone.

F012
DYNAMO 1: A COST EFFECTIVE SOLUTION TO TREATMENT PROBLEMS,

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Water and Wastes Engineering, Vol. 14, No. 9, p 121-124, 126, September, 1977. 4 fig, 2 tab.

DYNAMO-1, a first-generation dynamic computer programming model, was developed to evaluate and select the optimum waste water treatment alternative for a given raw waste load and effluent quality requirements from a series of 3,000 treatment alternatives. A multi-stage decision system which incorporates five factors per stage is used to find the maximum/minimum return configurations. Each stage examines the input state, output state, a decision variable, a stage return, and a stage transformation. Decision-making is based on a "backwards" approach to find the optimal policy for each stage of a given state. A design/cost algorithm was developed to select the most cost-effective alternative from the range of possibilities. Since the program was designed to begin at the last step in the treatment process and end with a treatment stage representing raw waste entering the plant, the choice of treatment scheme is based on the raw waste load which the alternative is designed to handle and on the most cost-effective solution. A summary of alternatives considered by DYNAMO-1 in the analysis of designs is presented for a 10-mgd municipal waste water treatment plant on the basis of raw waste characteristics of BOD at 220 mg/liter and TSS at 150 mg/liter and effluent requirements of 20 mg/liter for both constituents.

F013

DOES POLLUTION ABATEMENT IMPROVE AQUATIC LIFE,

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Water and Wastes Engineering, Vol. 14, No. 9, p 108, 111-112, 158, September, 1977. 4 fig, 2 tab, 2 ref.

The environmental effects of water pollution control efforts are discussed with respect to finfish and benthic invertebrates in the Merrimack River in Massachusetts. SNSIM (Stream Network Simulation) was used as a computerized mathematical model for this analysis. The model, developed by the EPA in 1974, calculates carbonaceous BOD of a stream from carbonaceous BOD values for point source loads and tributaries. The dissolved oxygen content is calculated with respect to the oxygen demand from biochemical breakdown of nitrogenous wastes; algal production and respiration of oxygen; benthal oxygen demand; and diffusion of atmospheric oxygen. Reaction coefficients on which the model is based include the oxidation rate of nitrogenous BOD and carbonaceous BOD by bacteria, the rate of algal assimilation of ammonia and nitrate, and the diffusion rate of atmospheric oxygen into the river. Use of the model requires data preparation, model calibration and refinement, and water quality projections. The Merrimack River was divided into segments according to flow, velocity, cross-sectional area, and depth. Water quality projections were calculated on the basis of 7-day, 10-yr low flow conditions. Projections of aquatic organism response were evaluated according to the sensitivity of the organism to pollutants and a direct linear relationship between dissolved oxygen concentration and biological response. The study concluded that changes in resident aquatic organism populations were not widespread as a result of pollution abatement schedules, although substantial improvements were observed in certain highly polluted stretches of the river.

F014

CONSIDERATION OF SUSPENDED SOLIDS TRANSPORT IN ACTIVATED SLUDGE SYSTEMS SYNTHESIS: II. TOWER TYPE OF ACTIVATED SLUDGE SYSTEMS,

Erickson, L. E., Heydweiller, J. C., and Fan, L. T.

AIChE Symposium Series, Vol. 73, No. 167, p 112-134, 1977. 7 fig, 4 tab, 9 ref.

The optimal structure and process designs for a co-current multi-stage aeration tower and a secondary clarifier were examined in model studies with the structural parameter method of system synthesis. Schematic diagrams of an activated sludge system with one, two, and three tower stages are presented. A series of equations for mass balances with respect to substrate concentration, flow rates, organism concentration, specific growth rate, and other parameters for each stage is presented. Computation aspects of the model, such as the choice of independent variables, dependent variable constraints, and input requirements, are discussed. A set of dimensionless, non-linear algebraic equations is derived through the introduction of a series of dimensionless variables into the mass balance equations for organism concentration, substrate concentration, settling velocity, backflow rate, saturation, endogenous organism attrition rate, time, and the linear dispersion equation constant. The effects of the number of tower stages on the clarifier, fermentor, and total volumes are illustrated, as are the fraction of the system volume allocated to the tower fermentor, and the sludge recycle and wasting rates. Analyses indicated that the three tower stage system achieved the desired effluent quality with the smallest tower, clarifier, and total volumes, and that the fraction of organic waste which was metabolized also increased as the number of tower stages increased. The amount of suspended solids in the overflow increased as the number of tower stages increased.

F015

PERIODIC OPERATION OF AN ACTIVATED SLUDGE PROCESS,

Sincic, D., and Bailey, J. E.

AIChE Symposium Series, Vol. 73, No. 167, p 135-139, 1977. 2 fig, 9 ref.

A variety of studies have been conducted to develop a control design for the activated sludge process which would minimize the effects of disturbances on process performance and effluent quality. A mathematical modelling and simulation study of the application of periodic control to the activated sludge process is presented. The model is based on the activated sludge reactor as two ideal continuous flow stirred tank reactors. Assumptions include a constant recycle sludge concentration and a recycle substrate concentration equal to the substrate concentration in the activated sludge reactor effluent. A series of equations for the two-tank process are presented. The periodicity of the fluctuations in feed rate and composition is mathematically defined and used to modify the process variables. A variability index based on the mean square fluctuation of effluent substrate concentration about its mean is presented. Process conditions and parameters used during the calculations are defined, including recycle sludge concentration; average value and upper limit of sludge recycle flow rate; volume; sludge:substrate ratio; and the autocatalytic kinetics rate constant. The effects of optimal period control and steady control on the effluent substrate concentration are illustrated.

F016

NITRATE AND CHLORIDE POLLUTION OF AQUIFERS: A REGIONAL STUDY WITH THE AID OF A SINGLE-CELL MODEL,

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Water Resources Research, Vol. 12, No. 4, p 731-747, August, 1976. 15 fig, 6 tab, 7 ref.

Nitrate and chloride pollution of aquifers as a result of waste water disposal and the use of fertilizers in agricultural regions is of particular concern to public health authorities because of possible effects on potable water supplies. A single cell model has been developed to examine regional patterns of nitrate and chloride pollution of a coastal aquifer in Israel. Integration of pollution sources on the land surface, hydrological parameters of the aquifer and the unsaturated zone, and variations of chloride and nitrate concentration distributions in pumping wells are used to assess present concentrations and their respective sources and to predict future pollution trends on a regional scale. Transit time from land surface to the aquifer and nitrogen losses in the soil are used to represent hydrologic and biochemical processes in the unsaturated zone. Linear relationships are defined between the nitrogen quantities released on the surface and the quantities reaching the water table. The chloride ion was used as a conservative tracer to define the effective volume of groundwater in the mixing zone. The Monte Carlo technique was applied to predict trends in average groundwater concentration as a function of time. The forecasted nitrate and chloride values reveal the need for immediate action to alleviate groundwater pollution, especially because of the time lag factor between the loading reduction and the aquifer response. Thirteen alternative measures are presented for pollution abatement, including tertiary treatment of sewage and modifications in agricultural practices.

F017
FINITE ELEMENT SIMULATION OF OVERLAND AND CHANNEL FLOW,

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Department of Civil Engineering.

Transactions of the ASAE, Vol. 20, No. 4, p 705-712, July-August, 1977. 6 fig, 3 tab, 32 ref.

A mathematical model was developed to allow simulation of flood flows from a watershed with considerations for the effect of land-use changes on the runoff hydrograph. Previous approaches to hydrodynamic problems are reviewed, including numerical methods, the finite element numerical method, Galerkin's residual method, and the kinematic wave approximation. A mathematical derivation of the model used in this study is presented. Use of the models involves a discretization of the watershed into elements which reflect significant changes in characteristics such as slope and/or roughness. Input parameters to the model include the element sizes, the topographical characteristics of the watershed, and the storm event. The South River Watershed in Augusta County, Virginia, is used in an example of the application of the model. Hurricane Camille, a 12-hr storm, was used to test and calibrate the flood routing model. The effects of flood detention features on the discharge hydrograph were calculated. Population projections were used to re-evaluate each element in terms of its land-use characteristics predicted for the year 2000, and a modified hydrograph was calculated.

F018
MODEL TESTING AIDS SUCTION CHAMBER DESIGN,

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Water and Wastes Engineering, Vol. 14, No. 9, p 86-87, 91-93, September, 1977. 10 fig.

Model testing is suggested for the evaluation of alternate suction chamber designs for axial and mixed flow pumps. Problems encountered during the operation of the high specific speed pump for condenser circulating service, water filtration plants, and other systems requiring large quantities of water at relatively low heads have been related to inherent characteristics of the pump type. Since these can be influenced by suction chamber characteristics, proper design can also reduce operating costs and required floor space of the pumping system. Cavitation, air entrainment, overloading of the pump impeller, lowered capacity and efficiency, and bearing misalignment and vibration can all occur because of improper suction chamber design. The advantages of designing suction chambers with separate chambers for each pump are described. Adjustments in the bell-to-floor clearance and submergence are discussed with respect to pump performance. Techniques in model testing of hydraulic structures such as suction chambers are based on maintaining a geometric similarity and scale in the prototype so that problems can be anticipated and various modifications can be made in the design stage at relatively low cost, instead of after the full-scale model is in operation.

F019

NEAR OPTIMAL EFFLUENT CONTROL FOR AN EXISTING ACTIVATED SLUDGE WASTEWATER TREATMENT PROCESS,

Therien, N., Perdrieux, S., and Harrington, P.

AIChE Symposium Series, Vol. 73, No. 167, p 95-104, 1977. 11 fig, 2 tab, 19 ref.

The waste water treatment plant for Sherbrooke University Hospital in Sherbrooke, Quebec, Canada, was the site of an evaluation of a model for predicting the dynamic behavior of the activated sludge process with respect to a control action. In this study the control action involved direct injection of active solids into the aeration unit of an activated sludge process in time in order to minimize the mean daily concentration of organic substrate flowing out of the clarifier in response to variations in the influent. In the presentation of the mathematical model for the aerator-clarifier system, differential equations for the substrate and bioimass entering and leaving the aeration unit and clarifier are defined. A set of equations for the optimization of the control problem and for numerical synthesis of the control function are presented. Calculations indicated that a feasible control scheme for the Sherbrooke University Hospital to provide a pulse of solids in time could be realized by simply installing an on-off automatic timer activating an injection pump at the plant.

F020

A REVIEW OF FILM FLOW MODELING AS APPLIED TO TRICKLING FILTER SYSTEMS,

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AIChE Symposium Series, Vol. 73, No. 167, p 151-159, 1977. 7 fig, 20 ref.

The trickling filter has been used in waste water treatment as a means of biologically removing organic carbon from municipal and industrial wastes. Microorganisms grown and maintained on the surface of the filter media receive oxygen and remove nutrients from the liquid film of waste water on the surface media. Various mathematical models have been developed to describe trickling filter performance as a function of organic loading, hydraulic loading, depth, and recirculation. A general review of film flow models with emphasis on liquid-phase concepts which can be used to examine trickling filter performance is presented. Liquid phase film flow models based primarily on mass balances within the reactor include the general heterogeneous model, the reaction control model, the pseudo-homogeneous model, and models for hydraulic loading response and recirculation effects. Models based on the bacterial film and biological activity are also described.

F021

PERFORMANCE PREDICTIONS FOR THE REMOVAL OF AQUEOUS FREE CHLORINE BY PACKED BEDS OF GRANULAR ACTIVATED CARBON,

Suidan, M. T., Snoeyink, V. L., and Schmitz, R. A.

AIChE Symposium Series, Vol. 73, No. 166, p 18-24, 1977. 5 fig, 9 ref.

The chlorine residual in treated water and waste water may have deleterious effects such as toxicity to species in receiving waters; taste or odor in drinking water; and adverse effects on ion exchange resins and industrial processes. Various studies have been conducted on methods of dechlorination. A mathematical model for free chlorine reacting with activated carbon in a packed bed was used in studies to show the effect of pH, particle size, temperature, influent concentration, and flow rate and contact time on the breakthrough curve and on the buildup of surface oxides of carbon within the bed. The effect of pH on the breakthrough curve was examined at pH values of 4.0, 7.6, and 10.0. The reaction of chlorine with the carbon was slowest at pH 10. With influent concentrations of 1, 5, 20, and 100 mg/liter, the higher concentrations resulted in more rapid breakthrough of chlorine and more rapid poisoning of the carbon. Chlorine removal increased with a decrease in carbon particle size. Removal was greater at lower flow rates and at longer contact times. The reaction between chlorine and the carbon bed was slowed down appreciably with decreasing temperatures.

F022

CONSIDERATION OF SUSPENDED SOLIDS TRANSPORT IN ACTIVATED SLUDGE SYSTEM SYNTHESIS: I. SIMULTANEOUS USE OF CLARIFICATION AND SLUDGE THICKENING MODELS,

Erickson, L. E., Heydweiller, J. C., and Fan, L. T.

AIChE Symposium Series, Vol. 73, No. 167, p 105-111, 1977. 3 fig, 3 tab, 16 ref.

The design of an activated sludge system consisting of a completely mixed aeration vessel and a secondary clarifier was considered with respect to minimizing the total volume of the system. Since the optimization of designs for waste treatment systems is dependent on accurate descriptions of the various processes, mathematical models to describe clarification and thickening in secondary clarifiers have received considerable attention. A clarifier model which considers overflow and underflow (clarification and thickening) is presented. Equations for the flow balance around the secondary clarifier, the organism balance, and the organism concentration in the overflow stream are presented. Equations for the bulk, settling, and total downward flux of organisms in the clarifier are used to derive an expression for the limiting flux of organisms in the system. The optimization of a system design is described with respect to the balance equations, the organism concentration in the underflow, inlet conditions, the desired effluent quality, and the clarifier depth. The effects of operating conditions such as loading, recycle flow rate, and sludge wasting rate on actual clarifier performance are discussed.

F023

ESTABLISHING THE BASIS FOR A WASTEWATER TREATMENT PLANT DESIGN,

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Department of Civil Engineering.

Boletin de la Academia de Ciencias Fisicas, Mathematicas y Naturales, Caracas, Vol. 37, No. 111, p 31-46, First Trimester, 1977. 10 fig, 3 tab, 10 ref.

An analysis of the microbial processes in waste stabilization is presented as part of a discussion on the basic design concepts of aerobic, anaerobic, and facultative biological waste water treatment systems. Kinetic equations are presented for the net rate of growth of microorganisms and substrate utilization in biological treatment systems. Process efficiency is related to the specific removal of some soluble substrate or the combined removal of BOD in all forms. Aerated lagoons with biomass recycling and the continuous activated sludge process without biomass recycling comprise the major types of aerobic systems. Equations for materials balance, oxygen requirements, and sludge production in aerobic treatment systems are presented. Anaerobic degradation involves hydrolysis and subsequent fermentation of organic wastes with the conversion of volatile acids into methane and carbon dioxide by anaerobic bacteria. The optimum operating conditions for methane fermentation in an anaerobic system are discussed with respect to temperature, pH, oxidation-reduction potential, volatile acids concentration, and alkalinity. Facultative waste stabilization ponds rely on the oxidation of carbonaceous organics by aerobic and facultative bacteria, nitrification, reduction of carbonaceous organics by anaerobic bacteria, and oxygenation of surface liquids by algae. Guidelines are presented for pond depth, surface area, and temperature.

F024
TEMPERATURE EFFECTS ON THE ACTIVATED SLUDGE PROCESS,

Sayigh, B. A.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2327-2328, 1977.

Since the completely-mixed, continuous-flow activated sludge process is currently one of the most commonly used aerobic modes of biological waste water treatment, studies were conducted to study the effects of temperature variations on the kinetics and performance of the process. Domestic waste water, an organic chemicals industrial waste water, and the mixed waste water from several industries were used in laboratory experiments at 4, 10, 15, 20, and 30 C. The control parameter used in the laboratory-scale experiments was sludge age. Filtered COD, filtered TOC, and/or filtered BOD were used as measures of influent and effluent substrate concentrations. Mixed liquor volatile suspended solids (MLVSS) levels were used as an indication of microorganism concentration. The experiments examined the effect of temperature on kinetic coefficients governing cell synthesis, microorganism decay, soluble substrate utilization, and dissolved oxygen utilization. A mathematical model was presented for the interrelationship between steady state MLVSS concentrations, the net rate of MLVSS production, and sludge age.

F025
HEAVY METALS TRANSPORT MODEL IN A SLUDGE-TREATED SOIL,

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University Park,
Institute for Research on Land and Water Resources.

Journal of Environmental Quality, Vol. 6, No. 4, p 438-443, October-December, 1977. 5 fig, 4 tab, 25 ref.

A one-dimensional solute transport model was developed to describe the movement of Cu, Zn, and Cd in sludge-amended soils. Freundlich adsorption isotherms were used to describe the adsorption of the cationic forms by the soil. The miscible displacement of chloride ions through undisturbed soil cores was used to determine the dispersion coefficient. A 17-month simulation period, with sludge inputs during the first 37 days and between the 168th and 196th days, was initiated to test the model's ability to predict the movement of Cu, Zn, and Cd in 15- and 120-cm soil percolates. Although the model predicted virtually no movement of the metals at either depth, field studies revealed increases in concentration of 322, 422, and 833% for Cu, Zn, and Cd at 15 cm and 121, 305, and 800%, respectively, at the 120-cm depth. Accelerated movement of metals at times of high hydraulic loading through interconnecting soil channels was suggested as contributing to the large discrepancy between the predicted and observed values. Since the more highly soluble chelated forms of heavy metals may be transported to greater depths than their cationic counterparts, a partitioned model for metals transport was tested. The data generated indicated that mechanisms other than simple chelation are responsible for metals movement through soils.

F026

INTERACTIVE COMPUTER DESIGN OF WASTEWATER PLANTS,

Shoemaker, T. E., and Barkley, W. A.

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Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 919-934, October, 1977. 1 fig, 10 ref, 1 append.

Increased interest in higher level, more costly waste water treatment facilities has led to the need for more effective design practices. A variety of mathematical models have been developed to aid in treatment plant design. The two basic design approaches involve either effluent criteria and unit sizes or are directed toward upgrading existing facilities. Standard values and indices have been used in many models. Since treatment streams are often recycled to process units, programs have been developed to analyze and minimize recycling requirements. The use of low diagrams, stream parameters, and unit operation parameters is discussed with respect to unit process ordering and input requirements. A design example involving the addition of an activated sludge unit to an existing trickling filter plant is used to illustrate input parameters, computer output, and final sizes of the unit processes which have been calculated by an interactive computer program for waste water treatment plant design.

F027

A MODEL FOR THE SIMULATION OF RAINWATER RUNOFF IN SEWERS (Ein Modell zur Simulation des Regenabflusses in Kanalisationsnetzen),

Kaufmann, P.

Balzari Blaser Schudel, Ingenieure und Planer,
Bern, Switzerland.

Gas-Wasser-Abwasser, Vol. 57, No. 3, p 287-292, 1977. 14 fig, 1 tab.

An electronic program has been developed for the hydraulic analysis of drain pipes. ELCAN precisely simulates flow conditions in a sewer system, taking into consideration backwash, retention, and pipe or trunk pressure in the network. This type of calculation for sewer networks allows optimum use of existing pipelines, while minimizing unwarranted investments so that sewer construction will answer actual needs. A series of tests used in evaluating the model and its sensitivity is presented along with some examples of possible practical applications.

F028
THE MODELING OF ACTIVATED CARBON ADSORBERS IN THE PRESENCE OF BIO-OXIDATION,

Peel, R., and Benedek, A.

AIChE Symposium Series, Vol. 73, No. 166, p 25-35, 1977. 13 fig, 13 ref.

An activated carbon adsorption model which considers the effects of biological activity within the column is presented. The fact that substances introduced to the column may or may not be biodegradable and/or adsorbable has been considered. Input parameters required for the model include: bulk liquid and bacterial film diffusivities, particle diffusion coefficient, liquid phase mass transfer coefficient, bacterial film thickness, bacterial reaction rate, and the estimation of residual yield factor. Pilot plant data on physical-chemical treatment at the Dundas Water Pollution Control Center in Ontario, Canada, the Ewing-Lawrence Sewage Authority plant in New Jersey, and the Los Angeles County Sanitation Districts Advanced Waste Treatment Research Facility in Pomona, California, were simulated to test the model's validity. The specific biological reaction rates calculated for the three plants had a mean of 5.59 x 10 to the minus tenth g TOC/sq cm-sq sec with a standard deviation of 1.53 x 10 to the minus tenth g TOC/sq cm-sec.

F029
A PHYSICAL AND MATHEMATICAL MODEL OF MASS TRANSFER AND REACTION KINETICS OF OZONATION,

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Boston, Massachusetts.

AIChE Symposium Series, Vol. 73, No. 166, p 188-205, 1977. 7 fig, 7 tab, 11 ref.

Since the exact mechanism of ozonation has not yet been established, a discussion is presented to delineate the fundamentals of ozonation with respect to mass transfer and reaction kinetics. A theoretical model which is presented assumes a first order relationship between the rate of mass transfer and the difference in the bulk phase concentrations of ozone. A two-step process is assumed for the model. Ozone is first transferred from gas to liquid by a mass transfer process which is not dependent upon chemical reaction. The chemical reaction between ozone and the waste material then proceeds without regard to mass transfer. Expressions for mass transfer of ozone from the gas phase to the liquid phase are derived with respect to a counter-current bubble column. The reaction rate constant and the order of the reaction are defined for the reaction of ozone with the dissolved and suspended substances in waste water. Results of kinetic studies on primary and secondary waste waters are presented. Bubble size, interfacial area, and residual ozone concentrations were determined in the studies.

F030

ACTIVATED SLUDGE-UNIFIED SYSTEM DESIGN AND OPERATION,

Keinath, T. M., Ryckman, M. D., Dana, C. H., and Hofer, D. A.

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Department of Environmental Systems Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE5, p 829-849, October, 1977. 11 fig, 2 tab, 19 ref, 1 append.

The settling flux approach can be adapted for evaluating economic tradeoffs between alternative designs for waste water treatment systems. The design basis for the aerator incorporates solids residence time and hydraulic residence time. The design basis for the clarifier incorporates the clarification constraint, and a recycle rate constraint. This methodology can be used for evaluating the economic aspects of an activated sludge system consisting of an aeration basin, clarifier, and sludge processing equipment. The settling flux approach can also be used in operations monitoring of an activated sludge system. This approach indicates that increased hydraulic flow rates would only cause solids to enter the effluent at certain critically located state points near the settling flux curve. For decreased hydraulic flow rates, the recycle rate could be reduced to the point of critical loading. The settling flux approach indicates that flow proportional recycle controls can estimate the required flow fairly accurately. It does not, however, provide the precise recycle rate required to maintain the clarifier in a critically loaded condition. This approach can also establish the hydraulic surge that a system could accommodate without indiscriminate solids wasting. This approach can only be used for operations monitoring and control if current settling flux curves are available. Changes in the operational set-point of solids residence time can be accommodated by changes in the solids wasting program.

F031

EFFECTS OF EXTERNAL MASS TRANSFER AND INTRAPARTICLE DIFFUSION ON ADSORPTION RATES IN SLURRY REACTORS,

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AIChE Symposium Series, Vol. 73, No. 166, p 91-98, 1977. 13 fig, 6 ref.

Studies were conducted to evaluate the relative effects of liquid and solid phase transport rates on the overall adsorption rate of carbon in slurry reactors. The effects of external mass transfer, unsteady state surface diffusion in the particle, and nonlinear adsorption isotherms were considered. The results of the study indicated that, in general, film diffusion controls the solute uptake rate in the initial stages, followed by particle diffusion in the latter stages. The initial uptake rates predicted by an adsorption model were compared with those of film diffusion-controlled adsorption. Negligible intraparticle diffusion resistance was considered a valid assumption for the initial adsorption period, in the case of solutes having a large solid-to-liquid phase equilibrium solute distribution. However, the errors were considered substantial beyond the first few minutes, especially at a high agitation power input. The effect of variation in the external mass transfer resistance on the concentration/time profile was examined for four solutes. At the same agitation speed, solutes having a high solid-to-liquid phase equilibrium solute distribution appeared to be more sensitive to the external mass transfer resistance. Substantial deviations in profiles were illustrated for variations of 20-30% in the mass transfer coefficient.

F032

MODELS FOR BATCH MIXING IN AIR AGITATED TANKS,

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Ontario, Canada,
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AIChE Symposium Series, Vol. 73, No. 167, p 6-14, 1977. 8 fig, 14 ref.

Efforts to develop a mathematical model to describe mixing in a batch aerated rectangular tank are described. Variations in the air flow rate and tank dimensions were used to test the model. The model for batch mixing is based on a two-dimensional description of the mixing phenomenon. Results of 17 experimental runs indicate that the vortex model for predicting mixing characteristics of an air-agitated tank provides an extension to computer models used for mixer design. Measurements of surface and bottom velocities at the mid-length of the tank are required by the model for estimation of the necessary velocities and diffusion coefficients. Extension of the approach to geometries other than the rectangular one used in the study is suggested.

F033

MAPPING THE LAG PHASE AND BOUNDING THE GROWTH PHASE IN FERMENTATION REACTIONS,

Tanner, R. D., Loo, A. C., Shisler, J. L., Reed, M. W., and Rowlett, R. D.

AIChE Symposium Series, Vol. 73, No. 167, p 55-65, 1977. 8 fig, 19 ref, 4 append.

An analytical expression has been derived for the initial transient domain (lag phase) of fermentation reactions, such as those which occur in the sludge fermentors used for liquid waste treatment. Parameters for gluconic acid fermentation were estimated to a first approximation. A model for pure culture fermentation was applied to mixed culture fermentation in liquid waste treatment. Used in conjunction with in vitro enzyme data for the glucose-gluconolactone-gluconic acid network, the approximation procedure was suggested as an efficient and feasible method of identifying a substrate-limited fermentation model. Examination of the complementary logarithmic-growth phase, typically described by a hyperbolic equation relating substrate concentration to specific cell growth rate, indicated that the lower bound for a simplified mass action fermentation kinetic model was defined by the Monod equation. The upper bound was defined by a hyperbolic quasi-equilibrium counterpart of the Monod equation. These boundaries are analogous to the Briggs-Haldane and Michaelis-Menten relationships, respectively, for the single intermediate enzyme reaction.

F034

A DYNAMIC KINETIC MODEL OF THE ACTIVATED SLUDGE PROCESS,

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Cupertino, California.

Biotechnology and Bioengineering, Vol. 19, No. 10, p 1431-1447, October, 1977. 7 fig, 11 ref.

A kinetic model for the activated sludge process based on the assumption that the rate of metabolism is primarily controlled by the enzyme concentration in the biological mass is presented. Four hypotheses for substrate utilization are described. A differential equation for the substrate concentration is derived and equilibrium conditions are defined. Solutions to the equations are presented for three feed functions which define a step decrease, a step increase, and an instantaneous change in the feed rate. Laboratory experiments with activated sludge were conducted to test the theoretical model's ability to predict substrate utilization in terms of CO2 production. Correspondence between the experimental results and the model calculations was favorable with respect to a yield factor.

F035

PRELIMINARY DESIGN OF WASTEWATER LAND APPLICATION SYSTEMS,

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Department of Agricultural and Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2371-2379, December, 1977. 6 tab, 14 ref.

A cost-effectiveness model for a spray irrigation system utilizing municipal waste water from a hypothetical northeastern U.S. city with a population of 50,000 is outlined. Cost estimates of the land application system incorporate factors for waste water storage pond preparation and maintainance, irrigation equipment, land purchase, and crop cultivation. Monthly precipitation averages, evaporation of waste water from the storage pond, and the nitrogen content of the soil and pond influent are also considered. Three of the 11 alternative proposed designs which varied in irrigation rates, pond capacity, irrigated area, maximum effluent and nitrogen concentrations in drainage, and estimated annual costs, are considered feasible. Although the land application system based on mass balance equations for nitrogen and water is only a preliminary design, the mathematical model can be adapted to outline cost-effective alternatives.

F036

ABSORPTION AND DECOMPOSITION OF OZONE IN AQUEOUS SOLUTIONS,

Kuo, C. H., Li, K. Y., Wen, C. P., and Weeks, J. L., Jr.

AIChE Symposium Series, Vol. 73, No. 166, p 230-241, 1977. 10 fig, 22 ref.

A stopped-flow spectrophotometer system was used to study kinetics of the decomposition of ozone in aqueous solutions. Experiments were conducted at 15, 25, and 35 C over a pH range of 2.2-11.0. The kinetics of ozone decomposition were found to follow a three-halves order relationship with respect to ozone concentration. The decomposition rate increased with the pH of the aqueous solutions. Differential equations governing molecular diffusion and decomposition in the ozone absorption process were solved by finite difference techniques. Absorption experiments were conducted utilizing a gas-liquid contacting reactor equipped with a gas disperser. The experimental data and theoretical results agreed in predicting build-up of absorbed ozone in an aqueous solution. They also indicated that it might be difficult to achieve a saturation concentration of absorbed ozone in an aqueous solution because of ozone depletion by decomposition during absorption. Ozone absorption under acidic conditions and at a moderate-to-fast gas flow rate was recommended for a high degree of ozone utilization.

F037
MASS TRANSFER COEFFICIENTS FOR THE OZONE-WATER SYSTEM,

Richards, D. A., Fleischman, M., and Ebersold, L. P.

AIChE Symposium Series, Vol. 73, No. 166, p 213-224, 1977. 5 fig, 7 tab, 8 ref.

A 0.75"-diam static mixer with 42 elements was used in studies on the ozonation of secondary effluents. Within 2-7 sec, the static mixer reduced COD and bacteria to the same extent as a Welsbach reactor could in 22 min. This suggested that ozonation of waste water was controlled by mass transfer. To examine the mass transfer characteristics in the absence of chemical reaction, a 2-4% by weight ozone-oxygen gas mixture was contacted with water in a 0.25"-diam static mixer having 21 elements housed in a horizontal glass tube. The ozone balance between the two phases was measured according to the quantity of ozone absorbed in water. The mass transfer coefficient for static mixing was at least twice that obtained without mixing for all combinations of flow rates tested. Overall mass transfer coefficients were related to the void fraction and Reynolds number. At low liquid flow rates, significant power loss was produced as a result of an increase in gas flow rate, although the mass transfer coefficient was relatively unchanged. Liquid phase resistance was found to be greater than gas phase resistance.

F038
DYNAMIC SIMULATION OF CONTINUOUS SEDIMENTATION,

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AIChE Symposium Series, Vol. 73, No. 167, p 49-54, 1977. 3 fig, 1 tab, 9 ref.

The assumption that only discrete layers of constant concentration and underflow rate exist in continuous sedimentation may not always be valid. The Chi-Howell model for settler dynamics is extended to account for continuous concentration variations with height in place of unallowable discontinuities. Discontinuous, layered solutions must sometimes be excluded because of Lax's generalized entropy condition, the generalized entropy condition for the partial differential equations describing the dynamics of the process. When this happens, a series of discrete layers which span the concentration range is inserted. The removal of unallowable concentration discontinuities can have a major effect on the simulated process dynamics and the dynamics and control system design for the integrated waste water treatment process.

F039
REGIONAL PLANNING FOR LAND APPLICATION OF WASTEWATER,

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Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2366-2370, December, 1977. 2 fig, 2 tab, 4 ref.

A cost-effective heuristic algorithm was designed to match secondary waste water treatment plants with applicable land disposal sites. Disposal sites already containing a land application system are termed 'open;' sites without a land application system are defined as 'closed.' The first step of the heuristic algorithm is the proposal of a regional plan. The second step is to determine the location of alternate, cost-effective, open land sites and to select the site which yields the highest potential saving. If none of the alternatives exhibits a positive potential saving, the third step in the algorithm is the reversal of open land sites and closed disposal sites. If this change results in a more cost-effective plan, the algorithm begins again at step two until all land disposal sites have been evaluated. If no potential savings are realized by considering closed sites as open and open sites as closed, sites are ranked according to the largest positive savings. The algorithm returns to the second step whenever a cost improvement is achieved. The algorithm can be used by planners and engineers to determine the most cost-effective land application site for a waste water treatment plant.

F040
MASS TRANSFER IN THE LIQUID PHASE WITH TUBULAR WASTE-WATER TREATMENT CONTACTOR,

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Research Laboratory of Resources Utilization.

Journal of Fermentation Technology, Vol. 55, No. 5, p 532-543, 1977. 11 fig, 3 tab, 5 ref, 1 append.

The effect of mass transfer on the removal of organic substances from waste liquid by a biological filter was examined in laboratory experiments employing a microbial film attached to a tubular contactor. Honeycomb and parallel plate supporters were used as tubular contactors. The microbial film was established by the circulation of a nutrient solution containing a high percentage of glucose through the supporters for several days. Simulated waste water, also containing glucose, was passed through the supporters on which microbes had grown. Rate controlling factors were determined through observation of liquid flow rates, the mass transfer resistance of organic substances or dissolved oxygen removal by the microbial film, and resistances of organic or dissolved oxygen diffusion. Honeycomb and parallel plate supporters with more complicated liquid flow routes produced higher glucose removal rates through the elimination of the effects of the liquid flow velocity. The effect of mass transfer was eliminated for the liquid phase as it was based on the liquid flow rates; the reaction rate controlling step was transferred to the microbial film. The dissolved oxygen concentration was shown to directly affect the reaction in the microbial film.

F041
HIGH-RATE DISINFECTION: CHLORINE VERSUS CHLORINE DIOXIDE,

Geisser, D. F., and Garver, S. R.

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Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 1089-1103, December, 1977. 10 fig, 5 tab, 14 ref, 1 append.

Pilot plant studies were used to compare high-rate disinfection of combined sewer overflow by the application of chlorine and chlorine dioxide. Mathematical performance models were developed to analyze the cost-effectiveness and the cost-benefit of chlorine and chlorine dioxide disinfection systems at a Rochester, New York, treatment facility. Multiple regression analysis indicated that chlorine disinfection was more effective with increased mixing intensity and larger detention times. Chlorine dioxide performed better than chlorine under conditions of low mixing intensity and short contact periods. The bacteria kill by chlorine dioxide as a function of BOD and mixing intensity was proportional to the dosage. Chlorine dioxide was also found to be more sensitive to changes in BOD of the waste water. Chlorine and chlorine dioxide disinfection effectiveness was not influenced by pH changes ranging 6.7-8.1. An insignificant increase in high-rate disinfection was realized by temperature increases from 2-30 C. Total and volatile suspended solids in the waste water did not influence high-rate disinfection. Although chlorine dioxide was more expensive, shorter detention times that offset capital expenditures were possible. High-intensity mixing with a short detention time was found to be the most cost-effective method for high-rate disinfection; chlorine, requiring minimum contact times of 3-6 min, was the more effective cost-performance method for treating combined sewer overflow.

F042
NITROGEN TRANSFORMATIONS IN LAND TREATMENT,

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Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 1075-1087, December, 1977. 4 fig, 1 tab, 21 ref, 1 append.

The nitrogen transformations occurring in an aerobic waste water storage basin before land application were measured in studies with an experimental waste water lagoon and simulated with a biological model. The biological model was based on the ratio of cellular nitrogen to chlorophyll as a function of the inorganic nitrogen concentration. Variations in radiation, temperature, and waste water properties are taken into account. The experimental aerobic storage lagoon collected waste water during three winter months at a rate of 6 gal/day. A fill-and-draw procedure was used to simulate land application treatment over a nine-month period. Daily measurements of dissolved organic nitrogen, algal cells, pH, temperature, dissolved oxygen, total organic carbon, ammonia, and nitrate were recorded. A significant reduction in the concentration of chlorophyll-A per cell and in the cellular nitrogen to chlorophyll-A ratio was observed during July and August. A comparison of model predictions and experimental lagoon measurements for concentrations of chlorophyll-A, organic-nitrogen, ammonia-nitrogen, and nitrate-nitrogen revealed similarities. The observed nitrogen concentrations were then examined with respect to the effects of spray irrigation on crops, land area, and hydraulic application rate of effluent. The inorganic nitrogen concentration decreased during June and July when rates of nitrogen uptake by plants increased. It was suggested that applications of unstored secondary effluent be combined with stored effluent to ensure adequate nitrogen levels.

F043
NEW APPROACH TO BACTERIAL KINETICS IN WASTEWATER,

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Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 1057-1074, December, 1977. 8 fig, 1 tab, 21 ref, 1 append.

A bacterial growth kinetics model is presented for the prediction of biomass growth and cell yield behavior based on substrate concentrations. The growth expressions predicted by this model are reduced to Monad-type rates for low, constant substrate concentrations. The kinetic model is examined with respect to data on the effects of dentrifying bacteria on dextrose metabolism. The kinetic model can be used to qualitatively predict the carbon to nitrogen ratio of the sludge during the activated sludge process. For a more accurate prediction, the relationship of substrate concentration to the carbon to nitrogen ratio must be clarified. The quantity of floc matrix material considered as stored substrate must also be determined. The kinetic model of bacterial growth also predicts the substrate uptake rates during contact stabilization, the delayed response of the activated sludge process after changes in influent concentration, and the difference between flow culture and batch culture cell yield.

F044

THE USE AND INTEGRATION OF GROUND AND SURFACE WATER MODELS IN THE 208 PLANNING PROCESS,

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AIChE Symposium Series, Vol. 73, No. 167, p 319-327, 1977. 10 fig, 13 ref.

Section 208 of the Federal Water Pollution Control Act Amendments of 1972 requires waste treatment management planning for areas with substantial water quality problems. The impact, interrelationships, and treatment alternatives must be identified and assessed for complex waste sources which may affect water quality. Waste treatment needs must be projected over a period of 20 years. Numerical hydrologic models and associated models for pollutant transport are important planning tools, allowing complex interrelationships between surface and groundwater quality, water supply, waste discharge, waste water treatment, and treatment alternatives to be assessed. The hydraulic and transport theories are well developed; equations exist which can be solved by existing computers to describe the systems. The development of a model to provide accurate assessments requires considerable hard data and knowledge of system parameters and boundaries. Because of the cost, time, and technology required, numerical modelling should be limited to complex problems where simpler methods are insufficient.

F045

CONVERTING WASTES TO ENERGY--A CONCEPTUAL APPROACH,

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Water and Sewage Works, Vol. 125, No. 2, p 44-47, February, 1978. 2 fig, 1 tab, 15 ref.

A mathematical model was developed for thermal energy recovery water reuse, steam generation, and methane gas production during sludge digestion of municipal wastes. The study was performed for a municipal area with a population of one million, producing 6 lb sewage/capita/day. The electric energy production rate from the municipal wastes in a high rate digester was calculated as 180,000 kw/day with a waste heat production of 960 Btu/hr. The total daily energy requirement for a population of one million was calculated to be 880,000 kw, indicating the need for an additional 6,000 tons of coal daily to supply the demand. The required digester capacity for a digestion temperature of 90 F, based on the total available waste heat, was calculated to be 100,000,000 cu ft. Based on a per capita water requirement of 160 gal/day, a water reuse loop system would provide 60% of the daily water demand by the municipality. Controlling factors in the production of fuel gas include: detention time; the percentage of methane in the digester gas; and the digestion temperature, which decreases detention time and methane percentage when it is increased but also increases heat requirements.

F046

EFFLUENT QUALITY VARIATION AT DIFFERENT ORGANIC LOADINGS WITH MULTICOMPONENT SUBSTRATE IN THE ACTIVATED SLUDGE PROCESS,

Siber, S.

Dissertation Abstracts International B, Vol. 38, No. 8, p 3616, 1978.

Parameters of substrate removal by activated sludge were examined in laboratory tests with a synthetic, organic multicomponent substrate used to simulate waste water. The substrate, a mixture of glucose, phenol, and sulfanilic acid, was treated with activated sludge in a continuous flow, completely-mixed laboratory-scale reactor. Parameters observed during the treatment process were the removal of substrate as measured by total organic carbon, removal at four food-to-microorganism ratios, influent and effluent quality, and the effect of sludge age on substrate removal. Combinations of the phenol, glucose, and sulfanilic acid were varied to more accurately approximate the removal, biodegradability, and influent concentration of each substrate. Overall removal rates were found to be the sum of the single substrate removal rates when analysed in terms of total organic carbon. A kinetics model was used to show the relationship of the parameters to effluent quality.

F047

NITRIFICATION AND NITROGEN REMOVAL,

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Corning Glass Works,
Corning, New York.

Water Research, Vol. 11, No. 10, p 897-925, 1977. 12 fig, 7 tab, 223 ref.

Various aspects of the use of nitrifying bacteria and nitrification processes in the aerobic biological treatment of waste water are discussed. The biochemistry of nitrification and characteristics of nitrifying bacteria are described. Recent literature on the effects of dissolved oxygen, temperature, pH, ammonia and nitrite ion concentrations, and the concentration of nitrifiers on nitrification processes is reviewed. The effects of sludge age, organic loading, detention time, surfaces, turbulence, light, micronutrients, organic matter, and microbial interactions are also considered. Mathematical models for nitrification and nitrifier growth kinetics are discussed with respect to the determination of kinetic constants, modelling of nitrifiers in attached growth and in streams, and the dynamic behavior of nitrifying systems. Single and combined stage processes for the removal of carbon, ammonia, and nitrogen from waste water are detailed.

F048

MATHEMATICAL MODELING AND ECONOMIC OPTIMIZATION OF WASTEWATER TREATMENT PLANTS,

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Catholic University of Louvain,
Belgium,
Department of Engineering.

Critical Reviews in Environmental Control, Vol. 8, No. 1, p 1-89, 1977.
10 fig, 11 tab, 231 ref.

Mathematical modeling procedures in waste water treatment plant processes were evaluated in an effort to achieve economic optimization of treatment facilities. A framework of treatment plant methods was developed for unit processes employing primary settlers, activated sludge aeration, secondary settlers, sludge thickening, sludge digestion, and press filtration. A review of mathematical models describing the kinetics of bacterial growth and substrate elimination was presented for single and multicomponent substrates, and microbial decay and growth stages. Model applications to biological treatment of waste water were evaluated with respect to kinetic parameters, including: oxygen demand, oxygen transfer efficiency, temperature effects, sedimentation, clarification, flocculation, and filtration. Mathematical models were developed for each of the treatment processes in the framework with respect to the interrelationships of the kinetics parameters. A study of dynamic models, trickling filters, thickening processes, anaerobic digestion kinetics, press filtration, and energy requirements of aeration devices was also conducted. Models of global treatment processes encompassing total plant operations and costs associated with each process unit were considered. The development of economic optimization models based on global models was attempted to maximize efficiency and minimize costs. The optimization study was directed toward activated sludge and anaerobic digestion processes, whole treatment plant cost minimization, and network optimization.

F049
SLUDGE COMPOSTING: A DISCUSSION OF ENGINEERING PRINCIPLES,

Haug, R. T., and Haug, L. A.

Regional Wastewater Solids Management Program,
Los Angeles-Orange County Metropolitan Area Project,
Whittier, California.

Compost Science, Vol. 18, No. 6, p 6-11, November-December, 1977. 7 fig, 1 tab.

Mathematical models were developed to represent the thermodynamic behavior of sludge composted by several techniques with and without amendments. The methods included: the windrow system, in which piles of waste are periodically rotated; the aerated pile system in which waste piles are maintained under aerobic conditions without turning; and the mechanical method, in which sludge is constantly rotated and aerated. A sludge composting mass balance equation, applicable to the aerated pile, the windrow, and the mechanical composting methods, was presented for calculating the quality of the compost material, recycle ratios for both dry and wet weights, the compost recycle solids, and the final desired solids contents. Techniques were developed for controlling volatile solids production during composting, based on the relationship to moisture content and mass balance. Volatility of the compost was found to decrease as the amount of cake solids decreased and recycled compost increased. Measures suggested for maintaining or increasing mixture volatility were: to increase the dewatered cake solids by drying the sludge before composting; to compost raw sludge rather than digested sludge solids; or to add a dry, degradable organic amendment. The volatilities examined exhibited a linear relationship to the total weight of the amendment required.

F050
SIMULATION STUDIES ON OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS,

Angelbeck, D. I., and Shah Alam, A. B.

Toledo University,
Ohio,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 31-39, January, 1978. 4 fig, 1 tab, 30 ref.

Optimization of the activated sludge treatment process of waste water was investigated in simulation studies with dynamic modelling. Two system differential equations were derived for the analysis of sludge and substrate mass balance. Microorganism mass balance in a completely mixed aerator was calculated as a function of influent sludge concentration and flow rate, microbial growth rate and endogenous decay rate coefficients, and dilution rates. Sinusoidal curves for system dynamics were used to evaluate the variations of influent microbial concentrations and substrate levels. System control was maintained by aerator detention time and sludge wastage rate. Optimal operational control of the system with a variational calculus technique minimized the disturbances in the effluent quality. Aerator detention time and sludge wastage rate were found to control the magnitude of the effect of system perturbations on the effluent quality.

F051
STATE VARIABLE MODEL FOR SEWER NETWORK FLOW ROUTING,

Mays, L. W., and Tung, Y-K.

Texas University,
Austin,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE1, p 15-30, February, 1978. 10 fig, 2 tab, 24 ref, 1 append.

A storm water flow prediction model, based on the state variable model, was developed for the design of sewer flow routing systems to regulate unsteady flow and runoff conditions. State variable modelling described flow as a function of input and output variables with respect to time factors. When applied in conjunction with an output equation, the state formula represented the relationship of input, output, and state variables over time. The mathematical model approximated the flow profile in a sewer with parameters measured by continuity and momentum equations. Application of the model to storm water routing through a single pipe produced symmetric, triangular inflow hydrographs. Comparison of the state variable model with other design equations indicated that valid sewer network designs could be obtained with the state formula. The model was applicable to linear or nonlinear, time-variant or invariant, and deterministic or stochastic network systems.

F052

MEASURING AND PREDICTING FLOTATION PERFORMANCE,

Gehr, R., and Henry, J. G.

Toronto University,
Ontario, Canada,

Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 203-215, February, 1978. 11 fig, 3 tab, 14 ref.

Techniques for measuring and predicting dissolved oxygen flotation performance in waste water treatment were developed in laboratory batch tests and full-scale continuous flow flotation experiments. The dissolved air flotation process, involving air introduction, pressurization, polymer addition, blending, and flotation, was evaluated with respect to a series of parameters measured in the effluent samples. An air saturation level of 90% was recorded after batch flotation; a saturation of 41-52% was measured in the continuous flow full-scale operation. The correlation between float solids concentration and the air-solids concentration was not significant. A thickening parameter was used in the batch tests to assess sludge amenability to flotation and to evaluate the effect of polymer dosage on flotation. When the thickening parameter was held constant during continuous flotation, changes in float solids concentration, recycle volume, influent volume, and available air mass could be predicted. Saturation levels in both batch and continuous flotation processes were 90% when the pressurizer in the continuous flow flotation operation was not allowed to clog. Flotation performance was directly dependent upon polymer dosage. Continuous flow flotation systems provided greater thickening and a clearer subnatant than the batch units.

F053

A BRANCH AND BOUND METHOD FOR USE IN PLANNING REGIONAL WASTEWATER TREATMENT SYSTEMS,

Brill, E. D., Jr., and Nakamura, M.

Illinois University,
Urbana,
Department of Civil Engineering.

Water Resources Research, Vol. 14, No. 1, p 109-118, February, 1978. 7 fig, 1 tab, 24 ref.

A branch and bound computational algorithm was devised for comparisons of economic and scale alternatives in constructing regional waste water treatment facilities and interceptor sewers. The mathematical model incorporates physical requirements, locations, sizes of facilities and interceptors into a sequential network of design alternatives. Each alternative outlines a configuration of treatment facilities and interceptors that is comparable to other solutions on the basis of qualitative and quantitative planning objectives. The linear functions of the algorithm are generated by inspection or by the computationally effective network algorithm. The branch and bound method produces systematic alternative plans and design evaluations rather than mathematically optimal solutions. The branch and bound algorithm was applied to a hypothetical regional waste water treatment facility planned for seven town point sources and 11 potential interceptors. The capacity of the method can be expanded to incorporate projected increasing waste flows to a facility.

F054

OPTIMIZATION OF DESIGN AND OPERATIONS OF ACTIVATED SLUDGE WASTEWATER TREATMENT SYSTEMS,

Craig, E. W.

Dissertation Abstracts International B, Vol. 38, No. 9, p 4414, 1978.

A Box-Complex algorithm was employed to optimize the design and operation of an activated sludge waste water treatment process with sludge reuse capability. The use of a nonlinear objective function and nonlinear, noncontinuous constraints with the Box technique permitted realistic models for unit processes. Predicted flow rates and a discrete time series definition were used in a plant performance technique developed for higher effluent quality at the lowest cost. A procedure for the optimization of an existing activated sludge plant with phosphorus reduction was designed to incorporate flow prediction data. A digital computer program was devised for plant optimization using the Box Search technique. Solids retention time and the recycle ratio were used as the control variables. According to the results of the computer program, substantial savings could be realized with flow rate predictions and other data.

F055

FACTORS INFLUENCING OXYGEN INPUT IN AERATORS WITH VERTICAL SHAFT (Az Oxigenbevitelt Befolyoasolo Tenyezok a Fueggoleges-Tengelyu Felueleti Levegoztetoknel),

Karoly, M.

Tatabanyai Szenbanyak Muszaki-Kozgazdasagi Koezlemenyei, Vol. 17, No. 1-2, p 12-16, 1977. 3 fig, 1 tab.

Design parameters of vertical shaft aerators and aerating basins which influence oxygen input were investigated. The oxygen input increases with the second power of the aerator diameter and with the second or third power of the circumferential speed; the efficiency is not influenced significantly by circumferential speeds in the range of 3.5-6.0 m/sec. Up to a certain level, oxygen input increases nearly linearly with the depth of immersion of the aerator. Although the oxygen input is intrinsically higher in rectangular basins than in circular ones, it can be increased in circular basins to yield an oxygen input of 1.7-1.9 kg/kWh by means of baffles which prevent or reduce the rotation of water around the aerator. For rectangular aeration basins, the specific oxygen input increases with a decrease in basin volume and is lower in rectangular shallow basins than it is in deeper basins of equal volume. Oxygen input is highest for rectangular basins having side length to water depth ratios in the range of 3-4:1.

F056

HYDRAULIC INVESTIGATION OF THE OPERATION OF DIFFERENT DESIGNS OF SECONDARY SETTLERS (Idravlicheskoe issledovanie rabot'l vtorichnjikh otstoinikov razlich'ikh konstrukcii),

Skirdov, I. V., and Kol'tsova, S. I.

Vodosnabzhenie i Sanitarnaia Tekhnika, No. 9, p 7-11, 1977. 4 fig, 6 ref.

Hydraulic characteristics of secondary vertical and radial settlers used in biological waste water treatment were examined. The performance of radial and vertical settlers was controlled by currents due to the difference in density between water and sludge. The currents generally limited the space utilization factor to less than 40%. Rotary distributors installed at the bottom of the settler were capable of increasing the space utilization factor to approximately 80-90%. The rotary distributors also increased the hydraulic load to a maximum of 2.2 cu m/sq m/hr, or nearly twice as high as that achieved in conventional radial settlers.

F057
PHOSPHORUS REMOVAL BY PRECIPITATION WITH FE (III),

Kavanaugh, M. C., Krejci, V., Weber, T., Eugster, J., and Roberts, P. V.

James M. Montgomery, Consulting Engineers, Incorporated,
Walnut Creek, California.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 216-233, February, 1978. 10 fig, 6 tab, 46 ref.

Waste water from Zurich, Switzerland, was used in pilot plant studies on phosphorus removal from biologically treated waste water with ferric under post precipitation conditions. Statistical models of ferric precipitation, shear flocculation, and filtration of suspended solids removal in the sludge blanket clarifier were developed. The performance controlling variables examined during physical-chemical treatment were pH, initial mixing, surface loading rates in the sludge blanket clarifier, the ferric/total phosphorus mole ratio, hydraulic residence time, and flocculation mixing intensity. Initial mixing in the 1.4 cu m/hr flow pilot plant was not an important factor. At pH 8.8, a significant amount of total phosphorus was removed. The reduction of soluble phosphorus, total phosphorus, and total organic carbon was significantly improved by increasing the ferric/total phosphorus mole ratio. Solids-liquid separation was the most significant factor influencing system performance. Surface loading controlled the solids removal from the sludge blanket clarifier. The models agreed significantly with observations and could be effective in evaluating other phosphorus removal techniques.

F058
CAPACITY PLANNING FOR REGIONAL WASTEWATER TREATMENT SYSTEMS,

Rossman, L. A.

Worcester Polytechnic Institute,
Massachusetts,
Department of Civil Engineering.

1977. 141 p, 17 fig, 12 tab, 33 ref, 1 append. NTIS Technical Report WPI/CE-77/1.

A computerized economic optimization model is developed for the preliminary design of a regional waste water facility to provide cost effective sites and service alternatives and capacity expansion schedules. A three phase heuristic procedure for solving the optimization model utilizes dynamic programming to minimize combined cost solutions and optimize waste flows; site locations are evaluated in terms of treatment options. The model incorporates design variations in pipeline connections between waste sources and treatment facilities; excess capacity in existing systems is also considered. Accommodations are also made for discount and inflation rates, pipeline costs for preliminary design limits, and treatment facility improvement costs. Application of the optimization model and a mixed interger program to a large scale problem results in similar solutions. The heuristic solution has the advantage of computation speed and accuracy over nonlinear cost or time periods. The model's flexibility allows for alternative objectives other than cost efficiency when parameters and limitations are changed.

F059

CLINOPTILOLITE COLUMN AMMONIA REMOVAL MODEL,

Semmens, M. J., Booth, A. C., and Tauxe, G. W.

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Minneapolis,
Department of Civil and Mineral Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE2, p 231-244, April, 1978. 11 fig, 2 tab, 20 ref.

Performance models were developed for the removal of ammonium by a column of clinoptilolite, a zeolite consisting of an aggregate of crystallites cemented together by quartz, feldspar, unaltered glass, and other impurities. Synthetic secondary effluent containing 95 mg Na, 21 mg Ca, 18 mg Mg, 6.5 mg K, and 358 mg alkalinity per liter at pH 8.0-8.5 was passed through a column packed with clinoptilolite that had been conditioned with sodium chloride, ammonium sulfate, and hydrochloric acid. In batch isotherm measurements, 0.0-5.80 gram aliquots of clinoptilolite were equilibrated in the synthetic waste water with ammonium additions of 10, 20, 40, and 50 mg/liter. The batch isotherms and breakthrough curves for clinoptilolite yielded a linear plot which was described by the Langmuir model. The ammonium capacities predicted according to batch isotherms were higher than those observed in actual column tests. An accumulation model, estimated by a finite difference technique, adequately predicted breakthrough curves under conditions of varying flow rate, ammonium concentrations, bed depth, and particle size. Batch isotherms accurately predicted ammonium removal by the column when the clinoptilolite was completely regenerated. In the case of incomplete regeneration, breakthrough curves for different ammonium concentrations were needed to accurately predict column performance.

F060
DEVELOPMENTS IN PERFORMANCE RELATIONSHIPS FOR SEWAGE,

Tebbutt, T. H. Y.

Birmingham University,
England,
Department of Civil Engineering.

Public Health Engineer, Vol. 6, No. 2, p 79-85, 1978. 9 fig, 21 ref.

Performance relationships based on operating conditions in pilot-scale primary sedimentation and activated sludge units are utilized to develop optimization models for sewage treatment plants. The performance relationships may be established by developing a theoretical model based on the nature of the treatment process and the principles of its operation or by formulating an empirical model to depict the mathematical or graphical relationships of observed performance. Performance data should be obtained with pilot-scale systems. The performance relationships in primary sedimentation are derived as a function of suspended solids removal efficiency, surface overflow rates, retention time, and various effluent characteristics. The organic removal rate in the activated sludge process is expressed as a function of the concentration of the organic matter, active biological solids, and time. The suspended solids removal efficiency of the final sedimentation tank is calculated with a model incorporating surface overflow rate, mixed liquor suspended solids, and time; it does not require data on the properties of the suspended solids. Performance relationships in the production and treatment of sludge are based on primary sedimentation performance. In the case of activated sludge units, they are represented as a function of solids accumulation, endogenous repiration, nonbiodegradable solids, and volatile solids in the influent and effluent. The performance relationships can be used to evaluate treatment plant designs on a least-cost basis.

F061
MODEL TESTS OF CIRCULAR SEWAGE SEDIMENTATION TANKS,

Christle, I. F., and Harbinson, R. W.

Edinburgh University,
Scotland,
Department of Civil Engineering.

Proceedings of the Institution of Civil Engineers (London), Vol. 65, Part 2, p 71-84, March, 1978. 6 fig, 3 tab, 29 ref.

Model studies of circular sewage sedimentation tanks were performed with quiescent columns of screened sewage and in model circular sedimentation tanks with deep cylindrical inlet baffles. The quiescent column tests with screened sewage yielded suspended solids reductions of 35% and 60% for initial suspended solids concentrations of 250 mg/liter and 600 mg/liter, respectively.

Suspended solids in composite sewage were reduced by 50% in the quiescent column tests. Flow pattern and sludge distribution analyses in circular sedimentation tanks indicated that four horizontal inlet plates with wide spacing produced the most uniform sludge distribution. Sludge deposition near the inlet was prevented in similar studies with a cylindrical inlet baffle. A comparison of the two inlet types in model sedimentation tanks receiving a flow of 35 cu m/sq m/day demonstrated that the cylindrical baffle, which reduced suspended solids by 31%, was more efficient than the horizontal plates, which reduced solids by 20-21%. These results indicated that detention time in the tank, rather than equal surface rating scaling, was the important factor in predicting full-scale tank performance.

F062

SOLUBILIZATION OF ORGANIC CARBON DURING THE ACID PHASE OF ANAEROBIC DIGESTION,

Eastman, J. A.

Dissertation Abstracts International B, Vol. 38, No. 9, p 4414-4415, 1978.

Soluble organic carbon produced during the acid phase of anaerobic digestion was evaluated as a substrate replacement in biological denitrification. A surrogate substrate containing dry dog food and cellulose at 25-35 C and pH 3.6-6.7 and primary sludge at 35 C and pH 5.1-6.7 were mixed separately in digestors operated with detention times of 9, 18, 36, and 72 hrs. The hydrolysis of particulate matter, rather than acid fermentation, was found to be the rate-limiting stage in the acid phase of digestion. Of the degradable materials in the surrogate substrate, starch was the most readily utilized, followed by nitrogenous matter; cellulose was used most slowly. For primary domestic sludge, carbohydrate degradation was 70% compared to 55% utilization of nitrogenous materials. Lipids were not utilized in the acid phase; methane generation was less than 10% of the COD. The temperature during dog food substrate digestion could more than double the rate of hydrolysis; solubilization increased with pH and detention time but was unaffected by initial volatile solids concentration. Acid phase steady state models for hydrolysis, bacterial growth, and product formation were formulated with first order functions, Monod's equation, and the COD balance, respectively. Up to 50% of the non-lipid COD was solubilized during the acid phase, indicating that organic carbon was a suitable substrate replacement during denitrification.

F063

BACTERIAL AEROSOLS RESULTING FROM SPRAY IRRIGATION WITH WASTEWATER,

Bausum, H. T., Schaub, S. A., Small, M. J., Highfill, J. A., and Sorber, C. A.

United States Army Medical Bioengineering Research and
Development Laboratory,
Frederick, Maryland.

1976. 143 p, 16 fig, 11 tab, 318 ref. NTIS Technical Report 7602.

Air-borne bacteria resulting from spray irrigation with chlorinated and unchlorinated waste water were quantified in on-site investigations at Ft. Huachuca, Arizona and in laboratory experiments. Air sampling equipment was adapted for detection of the aerobic and indicator bacteria present in treated and untreated effluent from the army installation. Aerobic bacteria reached a maximum aerosol density of 1,630/cu m nearest the spray irrigation source; bacterial aerosols from chlorinated effluent were as high as 20/cu m close to the source. Coliforms comprised 0.5% of the total aerobic bacteria, with half of the coliform population represented by Klebsiella. Conditions of low wind, atmospheric stability, and darkness increased the aerosol densities of the bacteria. A mathematical model, used in conjunction with fluorescein tracer data, predicted that 0.3% of the applied waste water aerosolized. With this aerosol figure, the model estimated that a downwind distance of 518-1,800 m from the source would be required to reduce air-borne bacteria to background levels. The diameter of viable aerosol bacterial aerosols averaged 4.5 micrometers, indicating that more than half were small enough for human aspiration. Laboratory tests determined the viability of enteric bacteria under varying humidity.

F064

STABILITY AND FLOCCULATION OF COLLOIDAL PARTICLES--PART 1,

Gregory, J.

Effluent and Water Treatment Journal, Vol. 17, No. 10, p 515, 517, 519-521, October, 1977. 5 fig, 15 ref.

Mathematical models were developed to describe the stability and flocculation kinetics of colloidal particles. Flocculation of colloidal particles occurs by either Brownian motion (perikinetic flocculation) or induced velocity gradients (orthokinetic flocculation). Both types of flocculation are rate dependent upon the collision rate which expresses the maximum flocculation rate. This rate can be described as a function of colloidal concentration, decreasing with time, and rate constant, indicating that perikinetic flocculation is a second-order process. Integration of the flocculation rate equation can provide particulate concentrations at a specific time. The rate of orthokinetic flocculation can be expressed as a function of shear rate, spherical particle diameter, and initial concentration of the particles. Perikinetic flocculation of spherical particles is described with an equation using Boltzmann's constant, absolute temperature, and water viscosity. A comparison of the orthokinetic and perikinetic rates indicates that orthokinetic flocculation is more significant for particles above 1 micron in diameter and for higher shear rates. Hydrophilic colloid flocculation occurs when water solubility is altered by temperature, or salt or ion additions. Hydrophobic colloids aggregate when the energy barrier formed by an excess electrical repulsion is reduced or removed. The zeta potential of the particle and solution can be measured by electrokinetic techniques.

F065

KINETIC AND EQUILIBRIUM ASPECTS OF FLOC COAGULATION,

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Nashville, Tennessee,
Department of Chemistry.

Separation and Science Technology, Vol. 13, No. 1, p 25-37, 1978. 2 fig, 4 tab, 13 ref.

The kinetics of colloidal flocculation were studied under various conditions of surface potential, ionic strength, particle size, temperature, and particle concentration. Mathematical models to describe flocculation were developed by modification of the Gouy-Chapman model of the electric double layer. The potential agglomeration of particles is calculated according to the height of the barriers created by the potential energy generated from dispersion forces and electrical forces of the particles. Flocculation of the particles with time is expressed by an integration of the floc distance probability equation, which is considered as a function of floc length, medium viscosity, and potential energy of the two flocs separated by a given distance. A time constant and boundary conditions of flocculation were predicted based upon the assumption that with a large time constant, potential colloidal stability and potential energy barriers between flocs increase, reducing flocculation. Equilibrium factors in particle agglomeration were dependent upon maintaining ambient temperature and a particle concentration greater than half the electrolyte concentration. The rate of the system's approach to equilibrium increased functionally with ionic strength increase. Ionic strengths below 0.01 mole/liter increased the potential barrier to the point of near colloidal stability.

F066

STRATIFICATION IN LABORATORY SIMULATIONS OF SHALLOW STABILIZATION PONDS,

Bokil, S. D., and Agrawal, G. D.

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Kanpur,
Department of Civil Engineering.

Water Research, Vol. 11, No. 12, p 1025-1030, 1977. 5 fig, 3 tab, 14 ref.

Laboratory simulations were used to calculate the biochemical stratification occurring in shallow waste water stabilization ponds. Light intensity in the laboratory stabilization ponds, with depths of 53.5 and 35.5 cm, was maintained at a constant value of 60 cal/sq cm/day; two organic feed rates were employed. Biochemical stratification occurred in both laboratory ponds; stratification consisted of a small lower anaerobic bottom layer and an upper aerobic layer whose depth size remained constant under variations in hydraulic loading and pond depth. Low alkalinity and BOD levels were apparent in the upper stratum; high alkalinity and BOD were found in the bottom layer. The rate of oxygen decrease in the upper layer was a function of depth in the absence of agitation and averaged 0.09 mg/liter/cm. Algae concentrations increased functionally with decreasing detention time. Light attenuation at the depth where algal concentrations were insignificant was 96% of the surface light intensity.

F067

CONTROL TESTS AND KINETICS OF ACTIVATED SLUDGE PROCESS,

Wang, L. K., Poon, C. P. C., and Wang, M. H.

Rensselaer Polytechnic Institute,
Troy, New York,
Department of Chemical and Environmental Engineering.

Water, Air, and Soil Pollution, Vol. 8, No. 3, p 315-351, August, 1977. 16 fig, 1 tab, 31 ref.

Mathematical models described the kinetics of the activated sludge process in complete-mix reactors with and without sludge recycle and in plug-flow reactors with sludge recycle. The process parameters of biodegradability and sludge acclimation were analyzed as a function of oxygen uptake rate based on dissolved oxygen concentrations. Definitions and standard evaluations of solids, sludge settling, sludge blanket, sludge units and substrate utilization were presented. Equations were developed to describe the interrelationships between hydraulic retention time, volumetric loading, sludge production, sludge wasting, and recirculation ratio for the three types of activated sludge reactors. The ratio of BOD to COD could be replaced with equations for calculating the BOD:total organic carbon ratio; methods of establishing 5-day BOD, initial BOD of the influent, ultimate BOD, residual BOD, and BOD at any given time period were presented. Mathematical models were also developed for calculating treatment efficiency, yield and endogenous respiration coefficients, growth rate, and sludge volume index. An energy-assimilation reaction model was designed to assess the nitrification and denitrification capacity of a system; an analytical procedure for calculating maximum nitrifying and denitrifying abilities was outlined.

F068
SIGNIFICANT CORRELATION EXISTS BETWEEN DESIGN TECHNIQUES,

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Virginia Polytechnic Institute and State University,
Blacksburg, Virginia,
Department of Civil Engineering.

Water and Wastes Engineering, Vol. 15, No. 1, p 50-52, January, 1978. 5 fig, 1 tab.

Correlations between rational and empirical design techniques of the activated sludge process are investigated with mathematical models. Rational techniques are based on microbial growth and degradation balanced with the utilization of materials to supply values for mean cell residence time, biological solids retention time, or sludge age. Empirical techniques utilize functions of hydraulic retention time, alone or in conjunction with oxygen uptake, BOD, and the food-to-microorganism ratio. Total Kjeldahl nitrogen (TKN) is a function of BOD, uptake rates of BOD or TKN, microorganism constant yield coefficient, influent flow rate, and influent and effluent BOD or TKN levels. Mean cell residence time is related to aeration basin volume, mixed liquor suspended solids, and flow rate; the food-to-microorganism ratio follows the ratio of flow rate and BOD or TKN concentrations to basin volume and mixed liquor suspended solids. When the mathematical models were applied to a 10 mgd treatment plant, BOD was metabolized at higher cell residence times with higher mixed liquor suspended solids. The food-to-microorganism ratio became smaller while nitrification occurred with increasing cell residence time and larger amounts of TKN.

F069

INAPPLICABILITY OF BATCH KINETIC DATA TO ANALYSIS OF SOIL TREATMENT SYSTEMS,

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San Francisco, California.

Journal Water Pollution Control Federation, Vol. 50, No. 2, p 386-389, February, 1978. 1 fig, 14 ref.

Mathematical models were unsuccessful in describing the kinetics of biochemical removal of organic carbon by plug flow through soil columns. An equation for calculating hydraulic retention time of a constant-density liquid is integrated with the initial and final reactant concentration. To calculate the residence time in a differential plug flow reactor, the flow streamline length, the liquid fraction, and the water velocity are considered as a function of the soil and waste water COD, the streamline flow distance, and the rate of COD removal. Activated sludge samples containing 330 mg/liter COD were filtered through packed soil columns; results were compared to batch anaerobic incubation data for COD reduction. The cell residence time equation was applicable only in designing plug flow systems where reaction rates were dependent upon concentrations and reactions involving only single chemical species. Batch incubation experiments provided unreliable COD reduction data in the soil columns because of spatial variations of the microorganism types in the soil. The batch data cannot, therefore, be utilized in soil treatment system designs.

F070

ADSORPTION IN THE ACTIVATED SLUDGE PROCESS,

Ekama, G. A., and Marais, G. V. R.

Cape Town University,
Rondebosch, South Africa,
Water Resouces and Public Health Engineering.

Water SA, Vol. 4, No. 1, p 39-48, January, 1978. 8 fig, 3 tab, 5 ref, 1 append.

The cause of sharp decreases in the oxygen consumption rate when waste water feed to an activated sludge reactor is stopped was investigated in laboratory tests. One unit was fed with COD-bearing influent containing low nitrogen levels during five test runs using a square wave system, equivalent to a 12 hr feeding period followed by a 12 hr period without feeding. The other unit was fed during three tests with influent at a constant COD concentration and low nitrogen levels at square wave additions of 24 mg NH4/hr. In the fourth test, the NH4 concentration was raised to 13.7 mg/hr. For the fifth test, the influent was spiked with an additional 20 mg NH4/hr. The units were monitored over a 10 hr period with sludge ages of 1.5 and 2.5 days. When the feeds were terminated, the unit fed on the square wave regimen exhibited an instantaneous steep reduction in oxygen consumption. The constant feed unit was unaffected. In the fifth test, both units displayed the same changes in oxygen consumption at feed termination. The oxygen consumption decline in the cyclically fed reactor was attributed to increased energy requirements for carbonaceous matter adsorption. An adsorption model incorporating the increased energy requirements was formulated in conjunction with Monod's nitrification equation and applied to the activated sludge model to improve process response predictions of oxygen consumption rate, effluent total Kjeldahl nitrogen, and nitrate concentrations.

F071

THE BEHAVIOR OF A POORLY DEGRADABLE MODEL SUBSTANCE DURING BIOLOGICAL PURIFICATION (Verhalten einer schwer abbaubaren Modellsubstanz bei der biologischen Reinigung),

Pedrag, I.

Institut fuer Wassversorgung, Abwasserbeseitigung und Raumplanung,
Technische Hochschule Darmstadt,
Darmstadt, West Germany.

GWF-Wasser/Abwasser, Vol. 119, No. 3, p 127-134, 1978. 12 fig, 1 tab, 15 ref.

Pentaerythritol was used as a model substance to study the behavior of substances which are not generally amenable to biological waste water treatment. Persistent substances are broken down by slow growing microorganisms which may not have sufficient time to develop in conventional aeration basins. These substances can be more efficiently handled by increasing the age of the activated sludge. This can be achieved by subdividing the biological treatment into two stages. The first stage is operated under high sludge loading conditions. The easily degradable substances are removed in this stage and some of the more persistent substances are converted by the microorganisms into more easily removed intermediates. The latter, along with the intact persistent substances, are removed in the second stage by microorganisms which have aged under low sludge loading conditions. The overall efficiency of the two-stage aeration system is equivalent to that of a conventional one-stage basin. The model studies with pentaerythritol demonstrate that hardly any degradation occurs during the first 2.5 days, after which pentaerythritol removal increases sharply until the 8th day.

F072

THE EFFECT OF TEMPERATURE ON THE GROWTH OF ACINETOBACTER CALCOACETICUS,

Du Preez, J. C., and Toerien, D. F.

Orange Free State University,
Bloemfontein, South Africa,
Department of Microbiology.

Water SA, Vol. 4, No. 1, p 10-13, January, 1978. 5 fig, 2 tab, 10 ref.

The activated sludge organism, Acinetobacter calcoaceticus, was cultered in an acetate medium and in Tryptone soy broth over a temperature range of 16-40 C to evaluate the influence of temperature on microbial growth. The growth rate of Acinetobacter calcoaceticus in the acetate medium peaked within a temperature range of 30-36 C; growth declined steadily until 40.6 C when growth ceased. The maximum specific growth rate was 1.17/hr; the pH of the acetate media ranged from an initial 6.7 to 8.6 during growth. Optimum temperature for growth in the Tryptone soy broth was 29-33 C, with growth ceasing above 37 C; the maximum specific growth rate was 1.28/hr. Arrhenius curves were plotted for the relationship between growth rate and temperature in both media. Activation energies calculated from the curves for Acinetobacter calcoaceticus in the soy broth ranged from 9.51-22.87 kilocalories; activation energies for the acetate medium ranged from 10.36-17.49 kilocalories. Optimum temperature for an activated sludge process utilizing A. calcoaceticus bacteria for fatty acid removal was considered to be 29-35 C.

F073

THE STABILITY OF SUSPENDED PARTICLES IN FLOCCULATION PROCESSES IN WATER AND WASTE WATER (Die Stabilitaet von suspendierten Feststoffen bei Flokkungsprozessen in Wasser und Abwasser),

Neis, U.

Zeitschrift fuer Wasser- und Abwasserforschung, Vol. 10, No. 6, p 183-192, 1977. 11 fig, 3 tab, 26 ref.

The impact of flocculation and precipitation on the kinetic behavior of aqueous suspensions containing silica, aluminum oxide, kaolinite, illite, montmorillonite, and bacillus cereus was investigated with particle count techniques. Flocculation rates varied for the suspensions of silica, aluminum hydroxide, and clays when simple or hydrolized salts and polyelectrolytes were employed as aggregating agents. Aggregation rates increased while flocs remained intact when the mean velocity gradient was increased to 100/sec. Under optimal concentration ranges of 3.1 million to 2.1 billion particles/ml, variations in hydrodynamic parameters did not affect the destabilizing efficiency of the flocculants. When aluminum salt was used as a precipitant rather than a flocculant, the aggregation of silica in aqueous suspensions was more successful.

F074

UNDERFLOW RATE AND CONTROL OF AN ACTIVATED SLUDGE PROCESS,

Schaffner, M. W., and Pipes, W. O.

Hoff-Weston Associates,
Cleveland, Ohio.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 20-30, January, 1978. 4 fig, 4 tab, 18 ref.

The limitation of the underflow solids concentration by the area of the settling tank was quantified with mathematical models relating batch settling velocity to solids concentrations. A logarithmic formula, based on Dick and Young's theory of continuous sludge thickening, empirically related the initial settling velocity to the varying initial concentrations of solids. A reciprocal formula, describing the initial settling velocity in batch settling tests, related the hypothetical settling velocity at an infinite solids concentration and the maximum batch solids flux to the initial solids concentration. When the equations were applied to data from batch settling tests conducted over a 1-mo period at a treatment plant, the empirical formula underestimated the underflow solids concentration while the reciprocal model overestimated the concentration. The underflow suspended solids in the batch settling tests also exceeded the values calculated from the sludge volume index by six-fold. The solids loading on the settling tank was always greater than the solids flux.

F075

REMOVAL OF DICHLORAMINE AND AMMONIA BY GRANULAR CARBON,

Kim, B. R., Snoeyink, V. L., and Schmitz, R. A.

Tennessee Valley Authority,
Chattanooga, Tennessee.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 122-133, January, 1978. 10 fig, 2 tab, 17 ref.

Mathematical models were derived for the removal of dichloramine and ammonia on activated carbon batch and packed bed reactors. Temperature, concentration, and particle size were monitored in closed batch experiments; pore diffusion coefficients were calculated from this data. The coefficients were used to solve an algebraic expression, obtained from the removal rate of dichloramine from bulk fluid on carbon, as a function of the average mass of dichloramine reacted with time for a unit weight of carbon. The data obtained from the packed bed models was applicable in the design and prediction of performance of activated carbon beds. Units employing different carbon types than these experiments required additional batch tests to ensure the accuracy of the mathematical models. The packed beds did not achieve a steady state condition; reaction rates decreased as surface oxides accumulated on the packed bed media.

F076

THE INFLUENCE OF PH AND ORGANIC LOADING ON THE FILAMENTOUS BULKING OF ACTIVATED SLUDGE,

Yasuda, M.

Toyama College of Technology,
Japan,
Department of Sanitary Engineering.

Transactions of the Japan Society of Civil Engineers, Vol. 8, p 131-132, 1976. 5 fig, 1 tab.

The growth of Sphaerotilus, an organism contributing to filamentous sludge bulking, in activated sludge was measured with respect to variations in pH, COD, temperature, and organic loading during laboratory experiments. The temperature of the 5 liter aeration tank and the 1.5 liter settling tank ranged from 18.5-29.4 C with an organic loading of 0.24 g COD/g volatile suspended solids/day and a hydraulic loading of 0.57 g COD/liter/day. Sphaerotilus growth increased when the pH of the aeration tank effluent was raised above pH 6; the organic and hydraulic loading rates did not significantly affect Sphaerotilus growth. When pH was varied from 6-9 with an organic loading of 0.30 g COD/liter/day, Sphaerotilus growth was stimulated. Above this pH range Sphaerotilus growth was not apparent; organic loading rates did not affect growth in the high pH ranges.

F077

DESIGN OF DRYING BEDS FOR SURPLUS ACTIVATED SLUDGE,

Vosloo, P. B. B.

Water Pollution Control, Vol. 77, No. 1, p 71-74, 1978. 1 fig, 2 ref.

An excess activated sludge drying bed was designed to act as both a settling tank and a drying bed. The settling/drying bed contains a 200-250 mm deep layer of fine, ungraded sand that may be obtained from the construction site. The rectangular bed has one end wall, opposite the sludge inlet, that acts as an overflow weir rising 300 mm above the sand level. A 150-300 mm wide channel runs between this weir and another located upstream; the channel is divided into 5 sections with drainage means 500 mm below the sand level, connecting to the main overflow weir which discharges into a downstream collecting trough. The drainage valves within the troughs are closed when the mixed liquor is introduced. Water in excess of the bed capacity spills over the main weir into the collection trough as sludge settles to a 100-200 mm thickness. The surface water is drained sequentially through the trough valves serving the 5 sections of the upstream weir at heights above the sand level of 75, 120, 165, 210, and 255 mm. Liquid that is not drained from the surface filters through the sand bed and the sludge layer is allowed to evaporate. The design application rate is 1.5 kg/sq m with an excess activated sludge drying time of 4 days.

F078
AUTOTHERMAL THERMOPHILIC AEROBIC DIGESTION,

Gould, M. S., and Drnevich, R. F.

Union Carbide Corporation,
Linde Division,
Tonawanda, New York.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE2, p 259-270, April, 1978. 3 fig, 2 tab, 7 ref, 1 append.

Autothermal thermophilic aerobic digestion with high purity oxygen aeration of sewage sludge was evaluated in pilot plant studies. Based on a stoichiometric oxygen-to-volatile solids ratio of 1.50, the heat generation coefficient was estimated as 9.150 BTU/lb oxidized volatile solids. Cell synthesis contributed to a higher net oxygen requirement of 1.6-1.8 lb oxygen/lb oxidized volatile solids. Oxygen aeration during the thermophilic operation increased the oxygen saturation of the system and significantly enhanced mass transfer with less aeration power input than air systems. Digestion systems and the pilot plant study utilized a two-stage operation in which heating was limited to the first stage with mass transfer heating of the second stage. An air aeration system was unable to attain thermophilic digestion without supplementary heat, was mass transfer limiting, and was unable to operate efficiently at high solids loading. An autothermal thermophilic digester with oxygen aeration was operated in the first stage at temperatures exceeding 50 C over a period of 1.4-2.3 days. Heat leaks and reduced mass transfer to the second stage necessitated insulation of the pilot plant. Volatile solids were reduced by 30-40% in the first stage at retention times of 1.4-2.3 days, with overall reductions of about 80%. The pilot plant operation reduced salmonellae and Pseudomonas aeruginosa to below detection limits.

F079

BIOLOGICAL FILTRATION THROUGH A PACKED-COLUMN,

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Universite des Sciences et Techniques du Languedoc,
Montpellier, France,
Laboratoire de Genie Chimique et Traitement des Eaux.

Water Research, Vol. 12, No. 1, p 41-46, 1978. 6 fig, 5 ref.

Mathematical models predicting porosity decrease, oxygen depletion, and purification efficiency in a packed column during biological filtration of waste water were tested in a laboratory column reactor packed with crushed brick and fed with a dissolved substrate. Porosity decrease is calculated from initial porosity of the packed column which is diminished by the ratio of initial biomass concentration to density as a partial product of the specific growth rate to oxygen transfer coefficient ratio minus the growth yield rate with respect to the specific growth rate and time. Oxygen depletion is determined as a function of influent oxygen concentration, the oxygen transfer coefficient according to the filtration velocity, the specific area, porosity, and the initial biomass concentration with respect to the specific growth rate and time. Purification efficiency is taken as the product of the height of column efficiency at a specific growth rate and time and the ratio of specific growth rate and initial biomass concentration to filtration velocity and initial substrate concentration. Performance predictions calculated from these design parameters agreed with data obtained with the laboratory packed column. Although certain assumptions in the models are oversimplified, the models are considered accurate enough for laboratory tests of filter designs.

F080

ENSURING CLARITY AND ACCURACY IN TORQUE DETERMINATIONS,

Boyle, W. H.

Water and Sewage Works, Vol. 125, No. 3, p 76-77, March, 1978. 1 fig, 1 tab.

Methods were developed to calculate running, alarm, shut-off, and peak torques for circular clarifiers. Torque may be represented as the squared product of the uniform sludge load and the radius of the clarifier. The drive unit of the clarifier usually operates at a single running torque for 90% of the time. Alarm torque, set at 120% of the running torque, warns of loads in excess of the design clarifier parameters, provides additional running torque, and protects the drive unit in the presence of excessive loads. Shut-off torque automatically stops operation of the clarifier under adverse or abnormal conditions and may be set at 140% of the running torque. Peak torque, determined by the manufacturer to be the absolute capacity of the drive unit, accommodates excessive loads for a duration of about 3 sec when torque increases too rapidly for the shut-off torque to respond; peak torque is usually twice the running torque. Torque values were calculated for a municipal primary clarifier with an 80-ft diameter and a uniform sludge load of 8 lbs/ft. From the initial torque equation and the modes of torque operation, torque values were calculated as 12,800 ft lbs for running, 15,360 ft lbs for alarm, 17,920 ft lbs for shut-off, and 25,600 ft lbs for peak torque.

F081

FACTORS INFLUENCING LOW SPEED SURFACE AERATION SELECTION,

Sherrard, H. H.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Civil Engineering.

Water and Sewage Works, Vol. 125, No. 2, p 32-35, February, 1978. 3 fig, 4 tab, 5 ref.

Parameters influencing the selection of low speed surface aerators are reviewed for activated sludge systems in which the kinetic coefficients for BOD and nitrification are known. Oxygen demands under different conditions are calculated from waste water treatability and subsequent biokinetic coefficients. From these values, sludge age is calculated for use in determining balanced biochemical stoichiometrical equations to predict oxygen demand by microorganisms. Stoichiometric equations are developed for calculating influent waste water BOD and total Kjeldahl nitrogen (TKN) concentrations, removal efficiencies of BOD and TKN, sludge production related to time, and the variable yield coefficient. The overall mass transfer coefficient under aerator design conditions is calculated for selecting the aerator shaft horsepower in conjunction with a nomograph. The mathematical models are applied to conditions in a 1 mgd waste water treatment facility treating effluent with BOD levels of 350 mg/liter. The results of the model studies demonstrate that greater horsepower capacities are required for tanks with larger aeration volumes, higher values of hydraulic retention time, and higher concentrations of TKN.

F082

CALCULATION AND COMPARISON OF ACTIVATED SLUDGE BASINS AS CONTINUOUS STIRRED TANK OR PLUG FLOW REACTORS,

Mehring, A., and Wiesmann, U.

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West Germany,
Institut fuer Chemieingenieurtechnik.

German Chemical Engineering, Vol. 1, No. 1, p 31-38, 1978. 11 fig, 2 tab, 29 ref.

A theoretical analysis of continuous activated sludge reactors operated as completely mixed continuous stirred tanks (CST) or as plug flow reactors (PF) without back-mixing considered the performance of reactors and their limiting conditions. The maximum recycle ratio was calculated as a function of the sludge recycle, thickening, and outlet ratios derived from the microorganism balance. Equations were developed for the dimensionless concentration of the substrate and of the microorganisms at the reactor inlet, the balance of substrates and microorganisms in dimensionless form, and the dimensionless substrate concentration at the outlet. The dimensionless mean cell residence time was derived as a function of assumed values of substrate concentration and recycle ratio. Significant fractional conversion was observed only after a specific mean residence time was exceeded. Application of the equations to PF and CST reactors with sludge recycle assumed a constant oxygen concentration in an isothermal and steady-state process. The results indicated that a higher minimum mean residence time was required by the PF reactor to avoid washout of the bacterial culture; PF reactors provided higher fractional conversion. With lower residence times and fractional conversion, the CST reactor was considered superior.

F083

SEWER NETWORK SCHEME FOR DIGITAL COMPUTATIONS,

Mays, L. W.

Texas University,
Austin,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE3, p 535-539, 1978. 3 fig, 4 ref.

Algorithmically-derived isonodal lines and node numbers describing the physical arrangement of multilevel branching municipal and storm sewer networks may be entered into digital computers for simpler optimization and hydraulic routing studies. The imaginary isonodal lines correlate manholes with pipe sections connecting to the sewer system outlet. Construction of the isonodal lines begins with the sewer system outlet and progresses upstream; number nodes are initiated upstream and proceed sequentially downstream on each isonodal line. A vector of connections describes the sets of node connections or links between adjacent isonodal lines. The algorithmic scheme permits description of systems with more than one outlet. Network pipeline data, such as length, diameter, flow, and roughness factor, can be stored in the computer for access through the isonodal lines or nodes. Computations associated with optimization models and hydraulic simulation models are performed by the computer using the stored information and flow scheme.

F084
LAB STUDY HELPS SOLVE AEROBIC DIGESTER PROBLEMS,

Benefield, L., Seyfarth, R., and Shindala, A.

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Boulder,
Department of Civil, Environmental, and Architectural
Engineering.

Water and Sewage Works, Vol. 125, Reference Number, p 60, 62-64, 66-68, 70, 1978. 20 fig, 13 ref.

Laboratory batch and continuous flow digesters were used to compare solids destruction rate coefficients, oxygen demand, and supernatant characteristics under temperature variations in studies to develop design parameters for continuous flow aerobic digesters. Acclimated sludge was digested on a batch feed mode at temperatures of 30, 40, and 50 C with aeration for 15 days. COD, nitrate, orthophosphate, oxygen uptake, and volatile suspended solids were measured after 5, 10, and 15 days of aeration. Similar conditions were maintained in continuous feed digesters; waste sludge was replaced daily with batch feed sludge for aeration times of 5, 10, and 15 days. Analyses were conducted over 7 days, after steady-state was reached. The modified Arrhenius relationship for calculating the reaction rate constant for volatile suspended solids degradation was not applicable to the temperature variations employed in the study. Specific oxygen uptake rates were highest in the continuous feed digester maintained at 30 C, lowest at 40 C, and constant between 5-15 days in all continuous digesters. COD values in batch and continuous digesters were significantly different; the highest COD levels in continuous digesters were observed at 50 C. Little variation in nitrate and orthophosphate levels in the batch and continuous digesters was apparent; nitrifying bacteria were sustained in the 40 C continuous digester but not in the 40 C batch digester.

F085
A MATHEMATICAL MODEL FOR OPTIMIZING CHLORINATION OF WASTE STABILIZATION LAGOON EFFLUENT,

Johnson, B. A.

Dissertation Abstracts International B, Vol. 38, No. 11, p 5529-5530, 1978.

A mathematical model was developed to optimize chlorination of oxidation lagoon effluent with varying characteristics in Logan, Utah. Chlorination of primary and secondary oxidation lagoon effluent was evaluated in an on-site test facility over a year-long period. Tests were also conducted on the chlorination of lagoon effluent after it had been filtered through sand. The bacterial removal efficiency of the lagoon system was also monitored. Contact periods of 1 hr or less adequately disinfected the lagoon effluent. Temperature, sulfide, and COD levels in the effluent controlled the chlorine dose required for adequate disinfection; filtered effluent required lower chlorine doses. The mathematical model predicted the chlorine dose required for varying effluent characteristics and optimized chlorination practices with design curves.

F086
RESPONSE OF ACTIVATED SLUDGE PROCESSES TO ORGANIC TRANSIENTS-KINETICS,

Selna, M. W., and Schroeder, E. D.

Los Angeles Sanitation Districts,
California.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 944-956, May, 1978. 15 fig, 3 tab, 21 ref.

The impact of square-wave transient loading variations, 2-7 times the steady-state organic levels, on growth rates, substrate utilization rates, and settling rates was investigated using mixed liquor from an activated sludge reactor. Mean cell residence time ranged over 5.5-11.5 days, with hydraulic residence times in the aeration tank of 6.0-6.9 hrs. Transient loading was accomplished by increasing the steady-state COD of 265 mg/liter to 520-1,950 mg COD/liter. The Monod equation adequately described the results when applied before step-down and when soluble effluent COD calculations were modified. Transient loading variations did not significantly affect suspended solids concentrations of sludges which initially had good settling properties; large deviations in growth rates and organic removal rates were observed. Soluble effluent COD increased significantly with square-wave transient loadings at four times the steady-state parameters. Results of the study indicated that effluent COD could be controlled by regulating steady-state unit growth rates as an inverse function of mean cell residence time; a 5-day mean cell residence time did not adversely affect substrate utilization.

F087
UTILIZING STOICHIOMETRY FOR DENITRIFICATION,

Sherrard, J. H., and Sivasubramanian, R.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Civil Engineering.

Water and Sewage Works, Vol. 125, No. 6, p 104-106, 108, June, 1978. 5 fig, 2 tab, 12 ref.

Balanced stoichiometric equations were used to calculate methanol additions and waste sludge production for denitrification of waste water under anaerobic conditions. Formulas were derived for predicting methanol requirements, biomass production, effluent waste concentration, waste treatment efficiency, sludge production, and variable cell yield coefficients. Utilizing predetermined kinetic coefficients of denitrification at 10, 20, and 30 C and an influent nitrate-nitrogen concentration of 14 mg/liter, the kinetic equations were solved for a selected initial methanol concentration; solutions were utilized to develop a stoichiometric equation for denitrification. From this balanced equation, methanol doses at various mean cell retentions times and temperatures were calculated as a function of observed cell yield coefficients. The study determined that methanol requirements for denitrification decreased with increasing mean cell retention time and increased with increasing temperature. Waste sludge production increased with shorter mean cell retention times and higher temperatures. Higher methanol doses were required for higher influent concentrations of nitrate-nitrogen and dissolved oxygen.

F088
DESIGN CRITERIA FOR DISSOLVED AIR FLOTATION,

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Permutit Company,
Zurn Industries,
Paramus, New Jersey.

Pollution Engineering, Vol. 10, No. 2, p 46-48, 1978. 5 fig.

Design criteria for dissolved air flotation systems are calculated in mathematical models optimizing hydraulic loading rates, solids loading rates, and the air-solids ratio. The optimum surface area of the separator at 100% efficiency is equal to the ratio of the waste water flow to the particle rise rate. Thus, any particle with a rise rate greater than or equal to the hydraulic loading rate or the detention/water depth ratio will ideally be removed by dissolved air flotation. Pilot plant studies demonstrate that solids removal efficiency at specific design hydraulic loading rates decreases when the solids loading rate increases. Pilot plant studies are recommended to calculate the design criteria for solids loading rates as related to the size of the thickening tank and dewatering equipment. The air-to-solids ratio for flotation systems is expressed as the product of the air solubility at atmospheric pressure (1.3 mg air wt/1 cc air), the efficiency factor, and the pressure per suspended solids in the waste water. When effluent recycle is incorporated into the system, the waste water flow rate is included in the design equation for the air-to-solids ratio.

F089

MULTI-PART EXAMPLE OF SOLIDS/VOLATILES RELATIONSHIPS,

Lee, D. A.

Water and Sewage Works, Vol. 125, Reference Number, p 188, April, 1978. 1 tab.

Mathematical models described the relationship between solids recovery and water removal in waste activated sludge thickening, filtering, and drying processes. The models were used in estimating appropriate sizes for process equipment and feed rates and calculating associated cost factors. Equations were developed which interrelated volatile removal on the filter press, solid sludge discharge, feed rate, and associated parameters of food solids content and moisture content in the final sludge product. The solids/volatiles analysis was applied to a thickener with a feed rate of 20 tons/hr and a sludge solids content of 7.8% prior to pressure filtration dewatering and drying. After filtration, the sludge solids content was 68.8%; a final 1.5% moisture content after drying was desired to make the sludge suitable as a fertilizer. Results from these calculations were used to approximate the fuel requirements associated with sludge drying.

F090

OPTIMAL PERIODIC CONTROL OF ACTIVATED SLUDGE PROCESSES - I. RESULTS FOR THE BASE CASE WITH MONOD/DECAY KINETICS,

Sincic, D., and Bailey, J. E.

Houston University,
Texas,
Department of Chemical Engineering.

Water Research, Vol. 12, No. 1, p 47-53, 1978. 9 fig, 3 tab, 9 ref.

Mathematical models incorporating Monod's equation and microbial decay kinetics are used to redesign continuous-stirred steady state activated sludge reactors to operate in an optimal periodic control mode. Under periodic operation, diurnal fluctuations are controlled in the base case design and variations in effluent substrate quantity are reduced. Mathematical models for optimal periodic operation include waste and sludge recycle flow rates, feed substrate concentration, objective function, and variability index. The periodic gain control strategy is based on a linearization of the system about a base periodic state. Using periodic flow configurations to minimize effluent substrate, the average effluent concentration is reduced by 38% compared to steady state operation. Treatment efficiency is be further improved by periodic variation in the sludge recycle flow rate. Simulated process parameters are used to illustrate the optimal periodic operation of the activated sludge reactors.

F091
PROCESS SELECTION FOR OPTIMAL MANAGEMENT OF REGIONAL WASTEWATER RESIDUALS,

Dick, R. I., Simmons, D. L., Ball, R. O., and Perlin, K.

Delaware University,
Newark,
Department of Civil Engineering.

1976. 269 p, 17 fig, 11 tab, 169 ref, 3 append. NTIS Technical Report NSF/RA-760578.

Mathematical models were developed for the optimal selection and integration of sludge treatment and disposal processes. This preliminary report on the first of two years of research focuses on sludge treatment processes culminating in land application. The mathematical models relate process performance to design and operation parameters and waste water and sludge characteristics. The models also incorporate capital and operating costs into the design of processes with selected sizes and operating strategies. Based on performance and cost data, a digital computer program outlined in the report identified the optimum integration of various processes. Parameters extraneous to the direct cost basis of the mathematical optimization scheme considered in this report included: public acceptance, environmental impact, and indirect costs and benefits. Limited data on sludge characteristics restricted the development of process variables such as mean cell retention time in activated sludge processes, sludge mixing, the impact of aerobic and anaerobic digestion for various temperatures and times on sludge thickening and dewatering, and the influence of conditioning practices on sludge dewaterability.

F092
APPLICATION OF MASS TRANSFER TO ROTATING BIOLOGICAL CONTACTORS,

Famularo, J., Mueller, J. A., and Mulligan, T.

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Westwood, New Jersey.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 653-671, April, 1978. 14 fig, 3 tab, 38 ref, 1 append.

Mass transfer and biological reaction kinetics were used to design fixed film rotating biological contactors. The Michaelis kinetic equations were used to describe the rates of oxygen consumption and substrate removal in a fixed film treatment process. Oxygen and substrate diffusion flux values were calculated as a function of oxygen or substrate diffusivity in the biofilm, oxygen or substrate concentration, and the organism yield coefficient. Mass transfer through the liquid phase to the biofilm interface in aerated sectors was dependent upon the liquid film oxygen and substrate concentrations and the oxygen and substrate mass transfer coefficients above the waterline. Similar equations were derived for mass transfer in submerged sectors. The mass transfer coefficients were expressed as a function of the liquid film thickness and the oxygen and substrate diffusivity in the biofilm. The rotating biological contactor model was tested in three pilot plant operations which treated municipal, pulp, and paper mill wastes. To determine and verify kinetic constants, the pilot plants were run at two hydraulic loadings. By incorporating mass transfer, hydraulic, and kinetic processes governing BOD removal, full-scale plant performance was predicted for various hydraulic loadings, waste strengths, media diameters, and rotational velocities. The models were also considered applicable for optimizing rotating biological contactor performance and incorporating nitrification.

F093
TEMPERATURE EFFECTS ON THE ACTIVATED SLUDGE PROCESS,

Sayigh, B. A., and Malina, J. F., Jr.

Texas University, Austin,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 678-687, April, 1978. 13 fig, 18 ref.

Process kinetics and performance efficiency were evaluated in a completely mixed continuous flow activated sludge reactor operated at 4, 10, 20, and 31 C with sludge ages of 0.5-3.0 days. The kinetic relationships between sludge yield, soluble substrate utilization, and oxygen uptake were described by empirical equations; the process parameters monitored included microbial growth, performance efficiencies, settling characteristics in terms of sludge volume index, and the volatile suspended solids content of the effluent. The cell synthesis coefficient was not influenced by the soluble substrate concentration of the influent or by temperatures in the range of 4-20 C; the coefficient decreased significantly at 31 C. When the sludge age was increased from 1 to 3 days, the ratio of the net yield coefficient to the cell synthesis coefficient decreased in the range of 4-20 C. The soluble substrate removal coefficient increased at 31 C; the removal efficiency was independent of temperature at a sludge age of 3 days or more. Effluent BOD was also consistently below 10 mg/liter at all temperatures at a sludge age of at least 3 days. Dissolved oxygen utilization decreased with decreasing temperatures. The sludge volume index in the range of 4-20 C was maintained at less than 200 mg/liter at all sludge ages; the index deteriorated at 31 C when the sludge age was less than 2.75 days. The effluent volatile suspended solids concentration decreased with increasing sludge age.

F094

A SIMPLE, EFFECTIVE TECHNIQUE FOR CONTROLLING SOLIDS RETENTION TIME IN ACTIVATED SLUDGE PLANTS,

Roper, R. E., Jr., and Grady, C. P. L., Jr.

H. B. Steeg and Associates Division,
HNTB,
Indianapolis, Indiana.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 702-708, April, 1978. 6 fig, 9 ref.

Operational charts were developed to assist activated sludge reactor operators in controlling the solids retention time. A hydraulic formula was employed to calculate the solids retention time in an activated sludge reactor as a function of aeration tank volume, waste sludge flow rate, and recycle ratio. The sludge wastage rate necessary to achieve any desired solids retention time was determined under the assumption that mixed liquor suspended solids loss in the effluent is negligible; the results of the analysis were presented graphically. A calibration chart was then devised to correlate the data in the hydraulic control chart to full-scale reactor parameters. A calibration coefficient, related to the effluent suspended solids/substrate removal ratio, was employed to correlate the hydraulically estimated and the actual solids retention time. Using full-scale plant data, a calibration chart was devised. The impact of recycle ratio adjustments on the plant performance was then calculated with a two-curved operating diagram. One set of curves depicted the maximum mixed liquor suspended solids loading capacity of the settler at a given recycle ratio. The other set of curves diagrammed the actual mixed liquor suspended solids concentration in the aeration chamber at a specific influent flow rate and concentration. The graphical technique was successfully used to operate a 5.45 cu m/day pilot plant.

F095

SHOCK LOAD RESPONSE OF ACTIVATED SLUDGE WITH CONSTANT RECYCLE SLUDGE CONCENTRATION,

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Nasr City, Cairo, Egypt,
School of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 764-774, April, 1978. 10 fig, 1 tab, 11 ref.

The cyclic and step shock loading response of an activated sludge system operated with a constant sludge recycle concentration was evaluated according to effluent quality stability. The reactor was operated with a normal influent organic substrate concentration of 500 mg/liter glucose and a cell recycle of 8,000 mg/liter. During step shock loading tests, the substrate concentration was increased from 500 mg/liter to 1,500 or 3,000 mg/liter and the recycle concentration remained constant. The three-fold increase in substrate concentration did not adversely affect effluent quality; six-fold substrate shocks produced a three-day transient period in the biomass before steady state resumed. Cyclic shock loading of the reactor was then performed at a cell recycle of 10,000 mg/liter. The reactor was fed on a diurnal schedule of 12 hrs at a substrate concentration of 500 mg/liter glucose, followed by 12 hrs at 1,500 mg/liter over an 18-day period. Minimal cyclic disturbance was observed in the effluent quality during the first week of pulsing shock loads. The significant cyclic peaks of total COD and suspended solids in the effluent decreased after the sixth day of operation and were negligible after the 10th day. The study concluded that high activated sludge reactor performance could be expected under shock load conditions when the cell recycle concentration was held constant.

F096

FACTORS AFFECTING THE DESIGN OF DISSOLVED AIR FLOTATION SYSTEMS,

Gulas, V., Lindsey, R., Benefield, L., and Randall, C.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1835-1840, July, 1978. 8 fig, 1 tab, 5 ref.

A design procedure, based on the air-to-solids ratio in dissolved air flotation sludge thickening systems, incorporated the influence of sludge age and concentration on operating parameters. Three continuous flow dissolved air flotation reactors were operated with synthetic influent COD concentrations of 500, 1,000, and 1,500 mg/liter and sludge ages of 5, 10, and 13 days. Reactor performance was assessed according to effluent soluble COD, mixed liquor suspended solids concentration, oxygen uptake, and the sludge volume index; operating parameters monitored during flotation included the percentage of float solids, the subnatant suspended solids concentration, the float volume, and the rise rate of the interface. From laboratory reactor data, the design procedure established the relationships between sludge age and sludge volume index at varying seasonal temperatures; the float solids percentage and feed solids concentration were calculated for specific air-to-solids ratios. Relationships between the maximum float solids percentage and sludge volume index and between interfacial rise rates and feed solids concentration were also calculated at specific air-to-solids ratios. The air-to-solids ratio was derived from the feed solids concentration, soluble air concentration at 1 atm, the recirculation ratio, the gauge pressure, and the pressurization system efficiency. The maximum required thickener area was determined from the ratio of total influent flow at critical seasonal temperatures to the rise rate.

F097

PREDICTIVE MODEL FOR DESIGN OF FIXED-BED ADSORBERS: SINGLE-COMPONENT MODEL VERIFICATION,

Crittenden, J. C., and Weber, W. J., Jr.

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Pullman,
Department of Civil and Environmental Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE3, p 433-443, June, 1978. 8 fig, 2 tab, 4 ref, 1 append.

The simulation performance of the Michigan Adsorption Design and Applications Model (MADAM) for fixed bed adsorbers treating single component solutions was verified by four adsorption columns operated with varying fixed bed depths and hydraulic loadings. The dimensionless groups characterizing the model adsorption systems for single components included: the solute distribution parameter, representing the solid-to-liquid adsorbate concentration; the modified Stanton number, defining the liquid phase mass transfer removal efficiency; and the Sherwood number, comparing mass transfer resistances of solids and liquids. The adsorbate distribution parameters of the single solutes, phenol, p-bromophenol, p-toluene sulfonate, and dodecyl benzene sulfonate, ranged over 2,492-4,636; the Sherwood numbers ranged 0.857-17.0. The model simulations, which incorporated the two-step in-series transfer resistances and solids and liquid diffusion, adequately predicted single solute kinetics in the fixed bed adsorption systems. For verification of the model, the equilibrium uptake which was independent of the hydraulic loading was calculated in one of the columns and the result was used for other hydraulic loadings.

F098

SOURCES OF ERROR IN PARAMETER ESTIMATION FOR MATHEMATIC MODELS IN PROCESS KINETICS (Fehlerquellen der Parameterabschaetzung von methematischen Modellen der Prozesskinetik),

Moser, A.

GWF-Wasser/Abwasser, Vol. 119, No. 5, p 242-252, May, 1978. 17 fig, 2 tab, 36 ref, 1 append.

Potential errors in parameter estimations are cited for the development of mathematical models of activated sludge process kinetics required for optimization and automation. Simple models with a minimum number of process parameters are recommended; erroneous kinetic parameters should be avoided to prevent miscalculations. Variable physical properties that may be disregarded and result in faulty models include oxygen, carbon dioxide, pH, temperature, and sludge adsorption. Limited development of Monod or enzyme kinetics, reliance on stationary or mobile kinetics alone, and homogeneous or heterogeneous modelling can lead to reactor parameters that are valid only under ideal or limited conditions. Conditions inherent in individual processes that may be overlooked when model parameters are formulated should be identified through laboratory, pilot plant, and full-scale evaluations. These conditions include oxygen transfer, mixing characteristics, ideal flow deviations in continuous operations, electrode response time, and the dimensions of microbial flocs and films. Potential errors in the Monod kinetics and the Monod constant for the substrate concentration can result from pseudokinetic constants.

F099

ALLOCATIONAL INEFFICIENCY OF BENEFIT/COST APPLIED TO WATER AND SEWERAGE SUPPLY: INTERACTIONS BETWEEN TIME-SERIES AND CROSS-SECTIONAL MODELS,

Coelen, S. P., Bahl, R. W., and Warford, J. J.

Pennsylvania State University,
University Park,
Department of Economics.

Water Supply and Management, Vol. 2, No. 3, p 265-274, 1978. 1 fig, 3 tab, 13 ref.

Time-series, cost-benefit models to evaluate water facilities and sewerage projects are derived on the basis of increased property values associated with these projects. Both cross-sectional techniques, incorporating existing housing away from municipal areas, and time-series techniques, which estimate the increasing value of existing residential properties, are considered relevant for developing countries. The empirical cost-benefit analysis compares property value increases in a sewered or water-supplied control area to those in the proposed project area using time-series analysis; the average subset property sales within a given period of time are also compared to the control area indices. The time-series technique is considered analogous to cross-sectional analyses. The model is applied to a case study in Nairobi, Kenya, to verify that unpaid for benefits from investments in public sewerage and water facilities are reflected in increased land values.

F100
THE DEVELOPMENT OF AN INTEGRATED SYSTEM FOR WATER QUALITY MANAGEMENT PLANNING,

Sarsenski, J. E.

Dissertation Abstracts International B, Vol. 39, No. 11, p 5530, 1978.

Integrated models were designed to incorporate population and land use patterns, water quality criteria, waste treatment systems, and associated costs into water quality management system design. An epicenter model plotted as an ogee curve described the population density patterns and residential, commercial, and industrial land use relationships. The GENERATE model calculated waste water flows associated with the land use patterns. Residential flow was based on population density and per capita flow; commercial flow was dependent upon acreage and per acre flow coefficients; and industrial flow was taken from standard published data. A sewer model developed alternative interceptor designs which considered maximum waste loads and water quality standards. The results of the sewer model were incorporated into a treatment planning and cost model which calculated the land area requirements and associated costs of various treatment configurations. By varying the water quality parameters, the tradeoffs of specific water usages and treatment system costs were assessed. Planning tools to evaluate interrelationships between the various areas of water quality management were considered limited by the lack of an adequate data base.

F101
A DYNAMIC MODEL OF NITRIFICATION-DENTRIFICATION IN THE ACTIVATED SLUDGE SYSTEM WITH POWDERED ACTIVATED CARBON. (VOLUMES I AND II),

Lee, J. S.

Dissertation Abstracts International B, Vol. 38, No. 12, p 6106, 1978.

A dynamic model of suspended growth biological nitrification-denitrification was developed with data from two activated sludge pilot plants, one of which contained powdered activated carbon in the mixed liquor. The two reactors were operated with dynamic loading and were sampled every 2 hrs over 24-56 hr sampling periods. Effluent nitrate from both the nitrification and denitrification processes varied according to the cyclic flow and loading rates of the reactors; hydraulic and solids retention times directly controlled the degree of nitrification-denitrification. As dynamic loading increased, the concentration of non-biodegradable dissolved organic carbon increased in the nitrification effluent. The dynamic model, developed with a Newton-Shooting iteration computer program, predicted a higher substrate removal for powdered activated carbon. Activated sludge treatment with powdered activated carbon at 5 C required a higher microbial population to effect the same degree of nitrification-denitrification obtained at 20 C. Powdered activated carbon influenced denitrification kinetics; heterotrophic growth affected nitrification kinetics. The maximum growth rate coefficient was the most sensitive process parameter.

F102

PERFORMANCE OF A ROTATING BIOLOGICAL CONTACTOR UNDER VARYING WASTEWATER FLOW,

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Cedar Falls, Iowa.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 896-911, May, 1978. 10 fig, 17 tab, 16 ref.

Design criteria derived from a steady-state mathematical model was compared to the performance of a four-stage rotating biological contactor operating under varying waste water flows and strengths. The steady-state model calculated the coefficient of substrate removed/unit surface area of each disc as the product of Monod's half-velocity coefficient/area capacity constant and the effluent substrate concentration plus the area capacity constant. To verify the model under varying waste water flows and strengths, graphical analyses of the Monod coefficient and the area capacity constant were performed for each stage of the rotating biological contactor. Nitrification limited the model's ability to predict the removal of soluble BOD in the last two stages; model predictions for the first two stages closely correlated to pilot plant performance. In a plant with uniform surface areas in each of four stages, the model required a total surface area of 3,520,000 sq ft at a hydraulic loading rate of 2.27 gpd/sq ft; the graphical method predicted a total surface area of 3,709,000 sq ft at a hydraulic loading rate of 2.16 gpd/sq ft. Under fluctuating hydraulic and organic loads, the graphical method recommended a hydraulic loading rate of 1.61 gpd/sq ft; an 8 mgd plant operating at a hydraulic loading rate of 1.5 mgd/sq ft required a total contactor surface area of 5,300,000 sq ft.

F103
MIXING FIXED-SPEED PUMPS TO VARIABLE FLOWS,

Goldschmidt, G.

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London, Ontario, Canada.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1733-1741, July, 1978. 6 fig, 2 ref, 2 append.

Mathematical models investigated the adaptation of fixed speed screw pumps to variable storm water flows in collection chambers at lift stations. The objectives of the study were to match pumping and system parameters to the ranges of collection chamber inflows, to calculate a suitable control cycle, and to determine the cycle time between sequential pump starts when inflow exceeds the capacity of a pump. Other studies considered the critical inflow for minimum cycle time, the relationship between the water level in the tank and the pump discharge capacity, and the minimum storage volume required for a minimum pump cycle time under any inflow variation. Multiple pump operating sequences were determined by equations which calculated the distance between the control levels for the on and off pumps, the liquid level in the collection chamber above the off control level, the minimum recommended cycle time of the pump, and the pumping capacities of the pumps at the on and off control levels. The temporary trial storage volume heights were calculated for each pump. The combined pumping capacities were matched to the volume inflow rate. The critical inflows for minimum pump cycle time were derived from the volume flow rate, the portion of inflow exceeding pumping capacity at the on control level, the critical inflow parameter, the minimum cycle time and the area of the collection tank.

F104
LABORATORY STUDIES ON OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS,

Alam, A. B. S., and Angelback, D. I.

Schneider Engineers,
Bridgeville, Pennsylvania.

Journal Water Pollution Control Federation, Vol. 50, No. 7, p 1786-1803, July, 1978. 14 fig, 9 tab, 17 ref, 1 append.

A laboratory-scale activated sludge plant verified mathematical models to predict process performance parameters and optimize process control. The volatile sludge level in the aerator was calculated as a function of the specific growth rate correction due to a temperature change, the maximum specific growth rate coefficient at the reference temperature, the aerator effluent concentration, the sludge wastage flow rate, the clarifier sludge compaction ratio, the dilution rate, the endogenous decay rate, and the influent volatile sludge concentration. The effluent total dissolved organic carbon (TDOC) concentration was expressed as a function of dilution rate, influent substrate concentration, the specific growth rate correction, the maximum specific growth rate, the aerator sludge concentration, and the growth yield coefficient. The clarifier sludge compaction value was the ratio of the aerator volatile suspended solids fraction to the product of the sludge volume index and the aerator sludge concentration. Other model parameters included the sludge stratification coefficient, the ratio of recycle sludge to influent waste flow rate, and an overall performance function incorporating weighted matrices for state and control variables.

F105

AUTOMATIC CONTROL OF THE ACTIVATED SLUDGE PROCESS-I. DEVELOPMENT OF A SIMPLIFIED DYNAMIC MODEL,

Lech, R. F., Lim, H. C., Grady, C. P. L., Jr., and Koppel, L. B.

Exxon Company,
Baytown, Texas.

Water Research, Vol. 12, No. 2, p 81-90, 1978. 7 fig, 3 tab, 21 ref.

Mathematical models were developed to describe the dynamic behavior of primary settlers, biological reactors, and final settlers in the activated sludge process. Steady state mass balances were calculated for flow rate, soluble organics concentration, and suspended solids concentration in the primary settler. The values were applied to a model depicting solids removal as a function of the underflow stream parameters or the overflow rate. Models were also developed for the degree of thickening in the settler, the effect of influent suspended solids concentration and influent flow rate, and the effluent soluble substrate concentration. In the biological reactor, the concentration of the influent substrate was the sum of the soluble and suspended substrate leaving the primary settler; the specific microbial growth rate was calculated as a function of the surrounding substrate using Monod's equation. Models also described the net rate of biomass production, the true growth yield, the material balances for live cells and substrate, the concentration of the mixed liquor suspended solids, and the recycled sludge concentration. Several models were evaluated for calculating the effluent suspended solids concentration in the final settler; transfer functions for the biological reactor incorporated dead time and steady-state gain parameters.

F106
AUTOTROPHIC DENITRIFICATION USING ELEMENTAL SULFUR,

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Department of Civil Engineering.

Journal Water Pollution Control Federation Vol. 50, No. 8, p 1986-2001, August, 1978. 9 fig, 8 tab, 24 ref, 1 append.

The kinetic, stoichiometric, and solids separation properties of an autotrophic denitrification process employing Thiobacillus denitrificans were evaluated in five continuous-culture, anaerobic slurry reactors using elemental sulfur. Steady-state stoichiometric reactions and nitrate removal were calculated for various solids retention times; the maximum denitrification rate was then determined for ratios of elemental sulfur to biomass ranging over 45-194 mg/mg nitrate-nitrogen. A series of zone settling velocity and flocculant settling tests were conducted at several elemental sulfur concentrations. The observed biomass yield remained fairly constant within a range of growth rates, elemental sulfur-to-biomass values, and temperatures, indicating negligible microbial decay; a stoichiometric equation for autotrophic denitrification was derived from the average observed biomass yield and an empirical cell mass formula. Under steady-state conditions, the continuous flow reactors achieved about 99.5% nitrate removal. The maximum unit rate of denitrification was a linear function of the sulfur-to-biomass concentration ratio; the influence of temperature was described by the Arrhenius equation. Within the lower ranges of sulfur-to-biomass, smaller solid fluxes were produced; the solids flux was linearly related to the sulfur-biomass slurry solids level. The effluent suspended solids concentration was proportional to the overflow rate.

F107
KINETIC PARAMETERS AND RELATIVE TURNOVERS OF SOME IMPORTANT CATABOLIC REACTIONS IN DIGESTING SLUDGE,

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Department of Crop and Soil Sciences.

Applied and Environmental Microbiology, Vol. 36, No. 1, p 1-7, July, 1978. 4 fig, 4 tab, 24 ref.

The kinetics of fatty acid degradation, methanogenesis by acetate splitting, and lithotrophic methane generation were evaluated in laboratory-scale anaerobic digesters. Under steady-state conditions, the initial acetate concentration averaged 0.26 millimoles/liter with an average degradation rate of 0.27

millimoles/liter/hr; the acetate concentration was then increased to 1-2 millimoles/liter with sodium acetate under conditions of system saturation. Acetate degradation increased by 56% at saturation with a maximum degradation rate of 0.63 millimoles/liter/hr; the half-saturation concentration averaged 0.32 millimoles. Under steady-state conditions, the propionate concentration was less than 0.02 millimoles/liter with a degradation rate averaging 0.03 millimoles/liter/hr; at system saturation, propionate removal averaged 0.19 millimoles/liter/hr, attaining a maximum of 0.233 millimoles/liter/hr and a half-saturation concentration of 0.094 millimoles/liter. Hydrogen removal comprised less than 1% of the maximum potential degradation rate. Acetate splitting was considered the rate-limiting factor in anaerobic digestion. The unused hydrogen consumption capacity acted as a buffer for dissolved hydrogen partial pressures low enough for exergonic oxidation of fatty acids. Bacteria capable of anaerobic fatty acid oxidation and hydrogen generation were considered essential in methane-forming ecosystems.

F108

DYNAMICS AND CONTROL OF THE ACTIVATED SLUDGE WASTEWATER PROCESS,

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Painesville, Ohio.

AIChE Journal, Vol. 24, No. 4, p 693-698, July, 1978. 8 fig, 2 tab, 11 ref, 1 append.

Dynamic modelling of the reactor and the settling basin in an activated sludge system established a control strategy in which the settler underflow and recycle rates were maintained at a constant ratio with respect to the feed flow rate. The reactor model described the BOD and solids concentration in the reactor volume in terms of the volumetric flow rates, feed concentration, recycle stream, stoichiometric yield factor, and the reaction rate; the organism growth rate at a steady state in the reactor followed the Monod equation. Steady state modelling of the solids flux in the settler was based on a curve encompassing convective, gravity, and total fluxes. The settler was divided into zones of clarification, thickening, and compaction; concentration layers between the thickening and compaction zone were described by mass balance equations and the velocity of solids discontinuity. The response of settlers to two-step alterations in feed rate and to 24 hr cyclic feeds was simulated; underloading was found to destroy the buffering action of the sludge blanket and render the system unable to adequately resume steady state conditions. A compromise between controlling the sludge blanket level in the settler and the reactor solids concentration was reached by computing the optimum settler underflow rate for each feed rate and maintaining a constant underflow-to-feed rate ratio.

F109
HYDRAULIC ANALYSIS OF MODEL TREATMENT UNITS,

Hart, F. L., and Gupta, S. K.

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Montreal, Quebec, Canada,
Department of Civil Engineering and Applied Mechanics.

Journal of the Environmental Engineering Division-ASCE, Vol. 104, No. EE4, p 785-798, August, 1978. 9 fig, 6 tab, 15 ref, 1 append.

A technique incorporating dye tracing procedures was applied to a model chlorine contact chamber to provide design criteria for optimum treatment unit configuration. For a model or prototype unit with a fixed length scale and actual prototype flow, the required model flow was varied to obtain a tracer output paralleling the prototype response. For a prototype with a flow rate of 8.6 mgd, the required model flow with equal detention times was calculated as 10 gal/min; when designed according to the Froude number or the Reynolds number, the required flow was calculated as 29 gal/min or 710 gal/min, respectively. For a model with a 142 gal volume and a scale ratio of 1:8.43, the recovery of a fluorescent dye injected in the influent was measured with a fluorometer; the model flow rate was varied over 6.4-40.0 gal/min. Based on dye curve variations in the model and comparison of the relative magnitudes of model and prototype dye curves, a flow of 6.4-19.0 gal/min produced parameters closely correlated to the model performance. Thus, the design flow rate calculated by the data similitude technique was significantly lower than those rates recommended by the Froude or Reynolds numbers. The mean detention time index, the average detention index, the dead space fraction, the plug flow, the standard detention efficiency, and the fraction dead volume adequately simulated prototype performance.

F110
DESIGN 'EFFECTIVE' COST-EFFECTIVE SYSTEMS,

Lee, C. M.

Water and Wastes Engineering, Vol. 15, No. 7, p 66-68, 70, 72, July, 1978. 2 fig, 4 tab.

A five-step cost-effective analysis scheme was developed for designing and constructing municipal waste water treatment plants. The collection of baseline reference data in the first step provides an outline of project objectives, limitations and constraints, quality standards, and service loads; this information from local, regional, and state resources is interpreted into objectives for the individual waste treatment project. The second step defines the potential type of service load, operating schemes, and alternative configurations capable of achieving planning objectives. In the third step, mathematical cost-effective models simulate waste water treatment processes and predict system performance under various waste streams, time patterns, and operating constraints. From the models, the measure of effectiveness is evaluated for each treatment configuration and operating performance is predicted during regular and peak flow periods. Environmental, investment, annual operating, and research and development costs are then applied. Threshold levels for cost, effectiveness, and environmental impact are employed in step four to evaluate each alternative; the optimization of these threshold values is achieved through sensitivity analysis and trade offs. Treatment processes, cost, and configurations are manipulated to form the optimum threshold configuration. Once the alternative configuration has been decided, step five provides documentation of all design specifications.

F111

NITRIFICATION AND ALKALINITY RELATIONSHIPS IN ACTIVATED SLUDGE,

Benninger, R. W., and Sherrard, J. H.

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Lexington.

Journal Water Pollution Control Federation, Vol. 50, No. 9, p 2132-2142, September, 1978. 9 fig, 4 tab, 8 ref.

Alkalinity destruction during nitrification and factors influencing the oxidation of ammonia were investigated in laboratory-scale activated sludge systems, operated under steady state conditions with influent COD-to-total Kjeldahl nitrogen (TKN) ratios of 6.5:1 and 4.2:1. From nitrification reactions, stoichiometric calculations indicated that 7.14 mg alkalinity/liter were destroyed and 4.57 mg/liter O_2/liter were required to oxidize 1 mg ammonia/liter to nitrate-nitrogen. The activated sludge reactors were operated at several mean cell residence times up to 15.2 days. Mathematical models were derived for the minimum aeration time required to sustain nitrification, the mean cell residence time, and the observed yield coefficient. Greater mean cell residence times reduced TKN, ammonia, and alkalinity; larger COD:TKN ratios at a specific residence time also improved nitrification. Longer residence times also reduced TKN in the sludge, reduced waste sludge production, and increased the nitrate content of the effluent; higher influent COD:TKN ratios reduced effluent TKN, ammonia, and nitrate levels. The ratio of alkalinity destroyed to TKN removed increased at longer residence times and lower COD:TKN ratios. The stoichiometric value initially calculated for alkalinity destruction proved to be higher than observed. TKN and ammonia were completely removed and COD reduced by 91.1% after 15.2 days at an influent COD:TKN ratio of 6.61:1.

F112

MATHEMATICAL MODELS OF BIOLOGICAL WASTE TREATMENT PROCESSES FOR THE DESIGN OF AERATION TANKS,

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Academy of Sciences,
Moscow.

Water Research, Vol. 12, No. 7, p 491-501, 1978. 8 fig, 1 tab, 32 ref.

Formal activated sludge process models which incorporated pollutant sorption by activated sludge flocs, as well as biooxidation, were developed for designing aeration tanks and stabilization tanks in completely-mixed and plug-flow systems. The reactor kinetics of organic matter consumption and activated sludge growth as described by Monod's equation were considered too general and limited to describe microbial growth and decay rates, the impact of growth rate saturation on substrates, and process inhibition by high organic loading and metabolic products. Nonlinear models describing biooxidation kinetics were presented for plug-flow, completely-mixed, and multiple-step aeration tanks; optimization of process kinetics for varying substrate characteristics was considered dependent upon the hydrodynamic regime of mixing within the aeration tank. Evaluation of process kinetics, using theoretical process parameter values, by the Monod equation and its derivatives concluded that sorption of organic materials by activated sludge was a significant factor not included in the kinetic models. Differential equations, which incorporated the total suspended solids concentration without stored substrate and the sorbed pollutant concentration, were developed to include the oxidation of stored substrate on and in the sludge flocs within the stabilization tank. Models incorporating sorbed substrate were developed for several activated sludge process control configurations.

F113

PHASE SEPARATION OF ANAEROBIC STABILIZATION BY KINETIC CONTROLS,

Massey, M. L., and Pohland, F. G.

Westvaco,
Covington, Virginia.

Journal Water Pollution Control Federation, Vol. 50, No. 9, p 2204-2222, September, 1978. 16 fig, 5 tab, 17 ref.

Examination of process kinetics of the acid and methane fermentation phases of anaerobic stabilization indicated that phase separation improved process stability and control and reduced the total required reactor volumes. Utilizing the continuous growth theory, mathematical models for both the acid and methane phase reactors described the specific growth rates of acid or methane formers, the concentrations of formers in the effluent, and the available substrate concentration. A retention time of 32.7 hrs or less in the acid reactor enhanced substrate conversion to volatile acids but inhibited the growth of methane-forming organisms and the utilization of volatile acids; the methane reactor retention times were varied over 46.9-133.9 hrs in three tests. Organic carbon in the acid reactor was primarily converted to acetic acid and propionic acid; the concentration of propionic acid exceeded that of acetic acid after 24 hrs retention. Although gravity settling and biomass recycling in the acid reactor enhanced process operation, the same procedure was not feasible in the methane reactor because of the poor settling properties of the biomass solids. In the acid phase, the kinetic models defined a maximum specific growth rate of 2.7/hr, a saturation constant of 2,583 mg COD/liter, a yield of 0.31 mg volatile suspended solids/mg COD utilized, and a decay constant of 0.065/hr. The methane phase yielded maximum specific growth rates of 0.43 and 0.86/day and saturation constants of 369 mg acetic acid and 164 mg butyric acid/liter for acetic and butyric acid-utilizers, respectively.

F114

CONTROL AMMONIA NITROGEN WITH SINGLE-STAGE NITRIFICATION - BIOLOGICAL CONVERSION OF AMMONIA CAN BE MADE USING THE ACTIVATED SLUDGE PROCESS,

Munch, W. L.

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Illinois.

Water and Wastes Engineering, Vol. 15, No. 2, p 16-20, August, 1978. 3 fig, 1 tab, 2 ref.

Control parameters were identified and mathematical models were developed for maintaining nitrification activity in activated sludge treatment reactors. Single-stage nitrification was dependent upon the solids retention time (SRT). The SRT, in turn, controlled the net microbial growth rate in the reactor, especially that of Nitrosomonas and Nitrobacter. The growth of nitrifying bacteria was also affected by temperature, ammonia-nitrogen, dissolved oxygen, pH, toxic metals, and organic compounds. The SRT, which must be increased for the growth of nitrifying bacteria, could be controlled by calculating the mixed liquor suspended solids concentration, the total aeration tank volume, and the sludge wasting rate. At a specific SRT, the aeration tank solids content was calculated from the mixed liquor suspended solids and the aeration tank volume; the sludge wasting rate was the quotient of the total solids level in the aeration tank and the solids retention time. The required waste sludge flow rate was obtained from the sludge wasting rate and the waste sludge solids concentration. Utilizing these mathematical models, the 1,440 mgd West-Southwest sewage treatment works in Stickney, Illinois, converted its four aeration facilities to simultaneous nitrification. A graph, developed from the model studies, depicted the optimum parameters for nitrification in each facility. Implementation of nitrification processes in the four units reduced effluent ammonia-nitrogen concentrations at the outfall to 0.7-4.6 mg/liter over a year-long period.

F115

PROBLEMS ON SUBSTRATE CONCENTRATION IN DESIGNING NITRIFICATION-DENITRIFICATION METHOD WATER TREATMENT PLANTS (Shoka datchiso ho mizushori puranto no sekkei ni okeru kishitsu nodo no mondai),

Fukunaga, S.

Ishikawa Harima Giho, Vol. 18, No. 3, p 243-246, 1978. 5 fig, 2 tab, 16 ref.

Laboratory experiments verified hypotheses obtained from a literature review that denitrification rates in waste water treatment systems were controlled by the concentration of methanol in the influent. In a nitrification-denitrification process, methanol was assumed to be a source of organic carbon which influenced the rate of denitrification. Tests conducted in a laboratory reactor revealed that the change of the denitrification rate along the process line was directly related to the concentration gradient of methanol in the appratus. Denitrification was also directly dependent upon the temperature maintained within the apparatus. Permissible concentrations of nitrogen in the influent and methanol in the effluent were cited as important considerations in designing denitrification systems.

HYDROLOGIC ASPECTS

H001

SAMPLING AND ANALYSIS OF MINNESOTA TRIBUTARIES AND MUNICIPAL POINT SOURCES TO LAKE SUPERIOR,

1975. 234 p, 2 fig, 4 tab, 7 ref, 2 append. Technical Report EPA-905/4-75-002.

Results of a sampling program to determine constituent loadings of Minnesota tributaries to Lake Superior are presented. The geology, topography, climate, and population of the study area are described. Sampling and analytical techniques used in the study are presented. Stream descriptions and stream flow values comprise the section on hydrology. Effluent standards and characteristics are presented for municipal-industrial discharges. Classification codes for the intrastate and interstate tributaries in the study area are listed. Water quality data are given for three subbasins, including the Nemadji River, the St. Louis River, and Lake Superior. Stream loadings for major tributaries in the sub-basins are given. Effluent quality and loadings are given for the four sewage treatment plants which discharge directly into Lake Superior. Appendices to the report include a summary of tributary and sewage treatment plant loadings, as well as lists of data obtained at tributaries and sewage treatment plants during the study.

H002

CHARACTERISTICS OF THE RUN-OFF RATE OF POLLUTION LOAD IN AN UNSEWERAGED AREA,

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Department of Engineering.

Technology Reports of the Kansai University, No. 18, p 111-120, March, 1977. 4 fig, 4 tab, 7 ref.

Studies were conducted on the Akashi River in Japan to determine average loading rates on the river and examine the river's capacity for self-purification. The objectives of the study were to characterize pollutant loading rates in an area which is not serviced by a sewage collection system, and to derive residence times of various pollutants as a function of their loading rates. A series of mathematical equations to determine residence times and loading rates are presented. Major factors affecting the degree of loading are rainfall, stream characteristics, vegetation, the amount of available pollutants, and previous accumulations. Major factors affecting residence times include permeation, erosion, absorption, and dilution. On-site data collections were used to test the validity of the model in predicting the residence times of

BOD, COD, suspended solids, total nitrogen, and total phosphorus. These parameters were measured at five locations along the Akashi River at Tokyo, Yokohama, Nagoya, Osaka, and Kobe. The survey indicated that at average flow rate much of the observed reduction in pollutants occurred over a short travel distance in the river, while at low flow rates the reduction occurred over a larger distance.

H003

OCCURRENCE AND DISTRIBUTION OF BACTERIAL INDICATORS AND PATHOGENS IN CANAL COMMUNITIES ALONG THE TEXAS COAST,

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Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Applied and Environmental Microbiology, Vol. 34, No. 2, p 139-149, August, 1977. 6 fig, 7 tab, 31 ref.

The occurrence and distribution of bacterial indicators and pathogens were examined in residential canals of six Texas coastal communities which use a variety of waste disposal methods. The disposal systems include three which utilized collection systems and treatment plants, one in which sewage was initially collected in septic tanks and which later changed to collection and treatment, and two in which disposal was 25% septic tank and 75% collection system and treatment plant. Other parameters measured for the canals included depth and age. Measurements of coliforms, fecal coliforms, and salmonellae were made in the surface water and bottom sediments of the canals over a 17-month period. The most-probable-number (MPN) method was used to analyze all samples. The results indicated that there was no significant correlation between organism concentrations and physical-chemical characteristics of canal waters such as temperature, pH, turbidity, and suspended solids. Organism concentrations, however, did decrease as the salinity increased. Levels of enteric bacteria in the sediment were higher, often by a factor of several logs, than in the accompanying surface water. The rapid increase in bacteria concentrations in surface waters was attributed to the desorption of bacteria in the sediment as a result of decreasing salinities.

H004
THE DELINEATION OF A POINT SOURCE PLUME BY THE STUDY OF BACTERIAL POPULATIONS,

Rao, S. S., and Bukata, R. P.

Canada Center for Inland Waters,
Applied Research Division,
Burlington, Ontario, Canada.

Journal of Applied Bacteriology, Vol. 43, No. 1, p 61-66, August, 1977. 6 fig, 5 ref.

The radial sampling grid method and remote sensing techniques were used to examine the plume of Niagara River water in Lake Ontario. Water samples were collected at nine sampling stations on four radii from the mouth of the Niagara River and analyzed for aerobic heterotrophic bacteria, coliforms, fecal coliforms, and fecal streptococci. Thermal scans over the Niagara plume and aerial infrared photography indicated that the thermal regimes established by the merging lake and river had the same spatial distribution as microbial populations. The aerobic heterotrophic bacterial populations were indicative of lake waters, while the coliforms and streptococci were indicative of river water. The microbiological data were used to define the main impact zone of the river, the zone of minor influence of the plume, and non-plume lake waters. Microbiological and air remote sensing measurements are suggested for use in studies on the dynamic interaction of lakes and rivers at the source of discharge.

H005
WASTEWATER TREATMENT THROUGH SOIL -- WITH SPECIAL REFERENCE TO SEPTIC TANK EFFLUENT TREATMENT,

Viraraghavan, T.

ADI Limited,
New Brunswick, Canada.

Journal of the Institution of Engineers (India), Vol. 57, Part EN 3, p 95-102, June, 1977. 5 fig, 3 tab, 44 ref.

Various hydrologic aspects which may influence waste water disposal with septic tank-soil absorption systems are discussed, including infiltration, percolation, evapotranspiration, and runoff. Major factors which control infiltration include soil porosity, moisture content, surface soil compaction, and the presence and type of vegetation. Studies on the effects of long-term, continuous water application on infiltration rates are described. Factors affecting percolation rates are discussed for saturated and unsaturated flow conditions. Modifications for septic tank effluent application to the Darcy equation are discussed for saturated and unsaturated percolation. Physical, chemical, and biological actions which help to remove pollutants from water as it travels through soil are described. Studies on filtration, the major physical mechanism by which waste water is purified in the soil, are described. Adsorption and ion exchange are discussed as chemical mechanisms. The role that soil bacteria play in waste water treatment is discussed. Typical characteristics of septic tank effluent are presented. Studies on the transport of sewage bacteria and viruses through soil systems are described. The fate and effects of specific chemical contaminants in septic tank effluents, including nitrogen, phosphates, surfactants, chloride, BOD, COD, and TOC, are discussed.

H006
THE RISING COST OF MAKING DESERTS BLOOM,

Agarwal, A.

Earthscan,
London, England.

New Scientist, Vol. 76, No. 1073, p 96-97, October, 1977.

Israel has adopted extensive programs to utilize marginal water resources such as storm runoff, brackish water, and treated waste water for irrigation and for artificial groundwater recharge. The Dan Region sewage reclamation project, designed to treat 130 mcm of sewage from the greater Tel Aviv area, is scheduled for completion in 1985. Treated sewage has also been used to prevent seawater intrusion into fresh groundwater. One of the major goals of the Israeli water program is to keep water consumption constant without limiting agricultural growth. Water-saving practices in use include drip and sprinkler irrigation, electronically controlled irrigation systems, and irrigation with brackish water. Since Israel's water system now operates as a closed cycle, salt and other dissolved materials such as pesticides, fertilizer nitrates, detergents, and minerals are not regularly flushed from the aquifer. Desalination plants are being considered for aquifer purification.

H007
EVALUATION OF LEACHATE CHARACTERISTICS AND PHYSICAL PROPERTIES OF COMPACTED MIXTURES OF FLY ASH AND WASTEWATER SLUDGE,

Helm, R. B.

Dissertation Abstracts International B, Vol. 37, No. 4, p 1804, October, 1976.

Laboratory investigations were used to assess the environmental impact of combined disposal of municipal waste water sludge and power plant fly ash as structural fill or in highway embankments. Various combinations of two municipal sludges and four different ashes were tested. Leachate characteristics, the extent of biological degradation of sludge organic matter, permeability, unconfined compressive strength, and the effects of calcium sulfate and lime as additives were examined. Analyses of the leachate samples measured pH, total dissolved solids, boron, copper, iron, manganese, nickel, lead, and zinc. Total organic carbon, sulfate, calcium, and magnesium were measured in selected samples. Leach pH ranged from 7.0 to 12.4, total dissolved solids from 400 to 3,800 ppm, and total organic carbon from 1 to 770 ppm. Trace elements which were suggested as posing a potential environmental hazard included boron and copper. Lime addition was capable of reducing the boron concentration to below 1 ppm and increasing the compressive strength up to 40 psi. No significant biological decomposition of organics was observed. Various statistical techniques were used in the data reduction.

H008

THE EFFECT OF THE SPRAY IRRIGATION OF SECONDARY TREATED EFFLUENT ON THE VEGETATION, SOILS AND GROUNDWATER QUALITY IN A NEW JERSEY PINE BARRENS HABITAT,

Sawhill, G. S.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2104, 1977.

The Stockton State College spray disposal system at Pomona, New Jersey, was the site of an investigation on the waste assimilative capacity of the sandy soils of the pine barrens region for secondary treated effluent. The study area is described as a pineoak ecosystem, having a continental climate with prevailing land and sea breezes and acidic sandy soils. The site received monthly applications of secondary treated effluent at average rates 2.13 ha-cm/ha. Analyses of seasonal samples of groundwater and effluent revealed significant variability in chemical constituents. The electrical conductivity, pH, and the concentrations of Ca, Mg, K, NH4-N, NO3-N, Cl, and SO4 were significantly higher in groundwater collected at the spray irrigation site than in the control area, with NO3-N exceeding EPA limits for potable water. Perturbations in prevailing species as well as in concentrations of total N, crude protein, Ca, Mg, Na, K, P, and Cl were observed in both summer and winter vegetation. Although groundwater levels were not affected, increased base saturation due to Ca and Na was observed.

H009

MOVEMENT OF PHOSPHORUS FROM A SEPTIC SYSTEM DRAINFIELD,

Sawhney, B. L., and Starr, J. L.

The Connecticut Agricultural Experiment Station,
New Haven, Connecticut.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2238-2242, November, 1977. 2 fig, 2 tab, 24 ref.

More than 9,500,000 cu m of waste water containing appreciable amounts of phosphorus is discharged daily through septic systems in the United States. Since existing data on phosphorus movement from septic system drainfields is limited, studies were conducted to examine the movement of phosphorus from a septic tank drainfield through the surrounding soil to groundwater and its eventual discharge to surface waters. Suction probes and tensiometers were installed at various depths below and distances from a 6-yr old septic system for collection of effluent solutions for phosphorus measurements and to determine the moisture distribution in the soil at different locations. Septic system effluent began to pond in the trench soon after use and reached a maximum height of approximately 48 cm after about 3 mos. The effluent accumulation was attributed to the development of a slime layer on soil surfaces which impeded vertical and horizontal infiltration. The waste water flow through the soil was primarily unsaturated and phosphorus movement occurred in both the downward and horizontal directions. Phosphorus concentrations of only 0.5 mg/liter at the 6-cm depth suggested that a soil with a deep water table below the drainfield could be used to treat waste water for a number of years, especially when resting periods are established to allow regeneration of phosphorus sorption sites in the soil.

H010
RECYCLING SEWAGE THROUGH PLANT COMMUNITIES,

Woodwell, G. M.

Marine Biological Laboratory,
Woods Hole, Massachusetts.

American Scientist, Vol. 65, No. 5, p 556-562, September-October, 1977. 6 fig, 13 ref.

Water is continuously taken up by municipal and industrial users and then discharged back to the natural environment where it undergoes purification. Although many sewage treatment plants have been constructed as means of pollution abatement, the toxins entering the environment still pose hazards to aquatic life and to subsequent users of the discharged waste water. The importance of natural vegetation has been considered with respect to the role that normal patterns of water and nutrient flows in nature play in the further purification of discharged sewage effluents. Various studies on the terrestrial absorption of sewage-borne nutrients are reviewed. The use of aquatic systems to purify waste water is discussed with respect to pilot studies involving meadows and a combination of marshes and ponds.

H011

TRANSLOCATION AND ATTENUATION OF WASTEWATER PHOSPHORUS IN STREAMS,

Carlson, G. A., Jr.

Dissertation Abstracts International B, Vol. 38, No. 5, p 2326, 1977.

Three small streams in calcareous soil zones in the western part of New York were sampled at points 5-17.5 km below waste discharge sites to assess their ability to assimilate phosphorus contained in the waste water. Stream discharge, dissolved and particulate phosphorus, chloride and calcium in the water column, and available phosphorus in the fixed bed sediments were measured bi-weekly from May to October. Equations describing the variation in these parameters along each stream under mean, high, and low flow conditions were defined using regression analysis. Chloride, used to test a conservative material's behavior, was conserved as load accumulated in a linear manner with reach. The concentration and load of dissolved phosphorus decayed exponentially with stream reach, with phosphorus load decreasing significantly downstream from each waste water outfall. Phosphorus concentration and load decayed exponentially at rates ranging 0.04-0.36/km. Concentrations of available phosphorus in sediment and the phosphorus distribution along each stream indicated significant uptake as the waste discharge's impact was ameliorated. The study concluded that sediments in streams flowing through calcareous soil have a high, long-term assimilative capacity for phosphorus; and phosphorus in the sediments and in the water column approached equilibrium.

H012

TRANSPORT OF HEAVY METALS IN A SLUDGE-TREATED FORESTED AREA,

Sidle, R. C., and Kardos, L. T.

West Virginia University,
Morgantown,
United States Department of Agriculture-Agricultural Research Service.

Journal of Environmental Quality, Vol. 6, No, 4, p 431-437, October-December, 1977. 10 tab, 16 ref.

The transport of selected heavy metals in a forested sludge disposal area was evaluated with respect to the distribution of metals in the extractable and total fractions of the soil and in the soil water percolate. Anaerobically digested sludge was applied to plots in a hardwood forest at rates of 12.71 and 26.96 metric tons of sludge solids/ha. Cu, Zn, and Cd loadings at the higher application rate were 24.50, 28.49, and 0.253 kg/ha, respectively. Percolate quantities of Cu, Zn, and Cd leaving the 120 cm soil depth at the high treatment rate were 0.3, 3.2, and 6.6% of the applied levels, respectively. The relative order of mobility in the soil was determined as Cd>Zn>Cu. Measurements of the 0.1N HCL extractable and total soil fractions of Cu, Zn, and Cd in samples collected before and after sludge application indicated that the relative order of extractability was Cu>Zn>Cd.

Analyses of Cr, Pb, Co, and Ni in 0.1N HCL soil extracts revealed an increase in the Cr and Ni concentration at the 0-7.5 cm depth as a result of sludge application.

H013

LEACHATE PRODUCTION AT SANITARY LANDFILL SITES,

Dass, P., Tamke, G. R., and Stoffel, C. M.

Owen Ayres and Associates, Incorporated,
Eau Claire, Wisconsin.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 981-988, December, 1977. 1 fig, 4 tab, 9 ref.

The effects of surface runoff, soil moisture storage, and evaportranspiration on the quality of leachate from a sanitary landfill were evaluated. Precipitation data over a 30-yr period and monthly precipitation rates were used for runoff coefficients to calculate monthly runoff. Four case studies were conducted on the Blue Valley sanitary landfill in Wisconsin using various water balance data and runoff coefficients. The first case study used monthly data on water balance parameters, including runoff, available moisture, evaporation, and an annual precipitation of 24.53 inches. The runoff coefficient of 0.065 inches produced an annual leachate of 3.75 inches. In the second case study, a runoff coefficient of 0.2 inches yielded an annual leachate of 2.04 inches. A runoff coefficient of 0.065 inches and a potential evapotranspiration of 15.0 inches produced an annual leachate of 7.94 inches. The same runoff coefficient, considered with an evapotranspiration potential of 20.0 inches and a maximum soil moisture of 4.80 inches available for plant use, produced a leachate of 3.01 inches in the fourth case study. The use of the runoff coefficient in the second case study was not recommended for the design of storm sewers. Reduced evapotranspiration in the third case study resulted in a larger quantity of leachate than obtained with the parameters used in the first case study. The depth of an effective root zone was calculated in the fourth case as 2 feet with a soil moisture capacity of 0.2 inches/inch.

H014

SEWAGE EFFLUENT ON PASTURE SHOWS LITTLE EFFECT,

Water and Wastes Engineering, Vol. 14, No. 12, p 14, December, 1977.

Supplementary irrigation with secondary treated sewage effluent has been shown to have little adverse affect on pasture land. Irrigation with sewage effluent in Lakeland, Florida, began in 1969 and averaged 25,000 gal/d per 30 acres of grazed pasture. Analyses of samples collected from nine monitor wells near the irrigation sight yielded low bacteria and coliform counts. Tests at four other monitor wells revealed the presence of fecal related bacteria. The pasture's water table varied 1.0-3.3 ft below the land surface. Percolation to a depth of 8 ft yielded a nitrogen concentration of less than 20% of the effluent nitrogen. Negligible increases of nitrogen were found at a depth of 20 ft and in down-gradient groundwater. A geological survey conducted by the Water Resources Division of Tallahassee, Florida, produced no evidence of ground water contamination by carbon or phosphorus.

H015

UNDERGROUND INJECTION OF LIQUID WASTE CAN BE ENVIRONMENTALLY SOUND,

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Geological Services Section,
Texas Water Quality Board,
Austin, Texas.

Water and Sewage Works, Vol. 124, No 12, p 62-63, December, 1977.

Subsurface injection can be an environmentally sound method of waste disposal. In Texas, the Disposal Well Act requires certification by the Texas Water Quality Board that wastes will not be injected into freshwater strata, protecting groundwater resources. Subsurface disposal of other wastes requires a thorough engineering and geological evaluation of the waste character, well design, construction, operation, and monitoring program. Injection is only permitted after other methods have been found less desirable with regard to environmental protection and dependability. A technical staff qualified to evaluate applications in light of current developments is required. Application for a permit requires an on-site inspection and a technical report including information on local topography and geology, chemical and physical characteristics of the waste, and average and maximum anticipated injection rates. Disposal wells are inspected routinely; routine measurements of surface injection pressures and water analyses are required. Safe abandonment of the injection well and the effect on improperly plugged wells in the vicinity must also be considered. Proper plugging confines the injected wastes to a specific area. Cement plugs must be properly placed at the top of the injection zone, across any formation producing oil or gas, and at the top and bottom of the surface casing.

H016
BEHAVIOR OF ANIONIC SURFACTANTS IN A SOIL-SEWAGE EFFLUENT SYSTEM,

Acher, A. J., and Yaron, B.

Agricultural Research Organization,
Institute of Soils and Water,
The Volcani Center,
Bet Dagan, Israel.

Journal of Environmental Quality, Vol. 6, No. 4, p 418-420, October-December, 1977. 5 fig, 2 tab, 11 ref.

The adsorption and desorption of anionic surfactants by soil during the application of water and sewage effluents was investigated. Sodium lauryl sulfate (NaLS), dodecyl benzene sulfonate sodium salt (DDBS), and linear alkyl aryl sulfonate (LAS) were applied in 1% aqueous solutions to a sandy regosol from Mivtachim, Israel and a clay grumusol from Tel Adashim, Israel. The soil was mixed with a combination of the anionic surfactant solution and sewage effluent from Nazareth or Haifa, Israel. The concentration of anionic surfactants was measured with the methylene blue active substances (MBAS) method. The affinity of the soil was lowest for DDBS and highest for NaLS. Microbial attack during adsorption from sewage effluent raised the soil's apparent adsorption capacity. The adsorption isotherms of the ionic surfactants were linear and the soil type controlled the rate of accumulation. The soil-adsorbed NaLS was completely fixed and could not be desorbed. The desorption rate of DDBS and LAS from soil was controlled by the initial concentration.

H017
IMPROVING SUBSURFACE DISPOSAL SYSTEM PERFORMANCE,

Jones, E. E., Jr.

Agricultural Research Center,
Beltsville, Maryland.

Journal of Environmental Health, Vol. 40, No. 4, p 186-190, 1978. 3 fig, 3 tab, 16 ref.

Factors influencing the longevity of domestic subsurface disposal systems, including oxidation potential, soil percolation, hydraulic loading, soil type, and weather, are discussed. Consideration of primary and secondary soil moisture is necessary in the construction of disposal systems. Increasing the soil moisture content reduces the oxidation potential of the soil to below the level required for the degradation of organic compounds. Excessive soil moisture content can lead to anaerobic conditions and early failure of the septic system. Time controlled, intermittent loading systems with manual override and overload alarm are recommended for hydraulic loading of sand over alternated systems, volume controlled intermittent systems, and direct gravity loading systems. The time-volume control system limits loading to 0.5 cm/hr with 4-10 doses daily. Intermittent uniform pressure distribution and alternated loading systems are recommended for silt and clay loam soils with percolation rates ranging 60-300 minutes/inch. Sandy loam soils have percolation rates ranging 1-12.9 minutes/inch. Soil disposal systems located in soils with percolation rates of 0-5 minutes/inch have an estimated life of 13-36 years for families of 1-6 members. Disposal system longevity is also calculated for fair and poorly percolated soils.

H018

PURIFICATION OF SECONDARY EFFLUENT IN A NATURAL SAND FILTER,

Aulenbach, D. B., Harris, R. R., and Reach, R. C.

Rensselaer Polytechnic Institute,
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Department of Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 86-94, January, 1978. 4 fig, 3 tab, 9 ref.

Depths at which secondary effluent contaminants are removed by a natural sand bed filter were determined with seepage samples from observation wells and lysimeters installed at the rapid infiltration sites used by the Lake George Village, New York, Sewage Treatment Plant. Secondary effluent from trickling filters was applied to 21 sand filtration beds covering a total area of 5.4 acres. Samples in the 20-meter sand filter were collected with lysimeters at depths of 3, 7, 11, and 18 meters. Analyses of the samples indicated that coliforms, BOD, COD, orthophosphate, ammonia nitrogen, and organic nitrogen were completely removed and nitrate-nitrogen levels were reduced to approximately 8 mg/liter. Chlorides and other soluble substances passed through the sand filter unchanged. Nitrate removal increased with depth of passage through the filter and almost complete nitrate removal was achieved by a depth of 18 meters. Orthophosphate was reduced to less than 0.1 mg/liter within the first 10 meters; total phosphate reductions decreased with depth. Phosphate levels decreased to less than 0.1 mg/liter during the spring. Copper concentrations were below 0.05 mg/liter for all samples analyzed. Levels of calcium, magnesium, alkalinity, iron, sodium, and potassium were also monitored.

H019
NITRATE LEACHING DURING LONG-TERM SPRAY IRRIGATION FOR TREATMENT OF SECONDARY SEWAGE EFFLUENT ON WOODLAND SITES,

Kook, J. E., and Kardos, L. T.

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University Park,
Department of Agronomy.

Journal of Environmental Quality, Vol. 7, No. 1, p 30-34, January-March, 1978.
5 fig, 3 tab, 16 ref.

Studies were conducted at two forested areas irrigated weekly with 5 cm of waste water to evaluate long-term effects of sewage effluent land applications on nitrate leaching. A hardwood forest received an average annual effluent loading of 293 kg/acre over a nine-year period. The study indicated that 83% of the total nitrate, more than 2,000 kg/acre, had leached from the hardwood site in six of the nine years. Analyses of the soil water at a depth of 120 cm showed an average nitrate concentration of 15 mg/liter, with a high of 30 mg/liter recorded during the latter part of 1969 and early 1970. Little nitrate reduction was achieved by dividing effluent applications into 2.5 cm twice weekly or reducing irrigation to 2.5 cm weekly. Nitrate concentrations at the 120-cm depth remained above the potable water nitrate limit of 10 mg/liter. A white spruce forest planted in well-drained clay loam was irrigated weekly with 5 cm of effluent over 9 months of the year beginning in 1963. Analyses of the soil water nitrate content at a depth of 120 cm showed an average concentration of less than 10 mg/liter. A total of 36% of the nitrate had leached from the site between the sixth and ninth years of the study. An increase in the rate of effluent irrigation to 7.5 cm/week resulted in a 75% leaching rate, with nitrate concentrations exceeding 10 mg/liter at the 120 cm depth.

H020
DECOMPOSITION OF SEWAGE SLUDGE COMPOST IN SOIL: II. PHOSPHORUS AND SULFUR TRANSFORMATIONS,

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Agricultural Research Service--United States Department of
Agriculture, Maryland.

Journal of Environmental Quality, Vol. 7, No. 1, p 119-123, 1978. 2 fig, 2 tab, 32 ref.

Varying amounts of sewage sludge compost were incubated for 54 days at 22 C in Evesboro loamy sand, Christiana silty clay loam, and Fauquier silt loam to evaluate the production of extractable phosphorus and sulfur. The sludge compost was incubated with carbon dioxide and ammonia and in applications of 0, 2, 4, and 6% of the dry weight. The amounts of extractable phosphorus and sulfur were dependent upon immobilization by iron and aluminum and mineralization by microbial activity. The Fauquier soil-sludge medium yielded the least amount of extractable phosphorus and sulfur, with initial immobilization followed by mineralization at 54 days. Phosphorus mineralization occurred initially in the Evesboro soil-sludge mixture, the medium with the highest extractable phosphorus, with immobilization at 54 days. Extractable sulfur increased in this mixture after 54 days. An initial increase in extractable phosphorus was observed in the Christiana soil-sludge mix, followed by a decrease of phosphorus during incubation. Extractable sulfur was immobilized in this mixture during the early incubation period; higher compost applications of 4 and 6% produced subsequent sulfur mineralization. Applications of sludge compost adequately supplied or altered phosphorus and sulfur concentrations for plant growth.

H021

MEASUREMENT OF TRICKLING FILTER EFFECT ON POLLUTED RIVERS (Messung des Benthaleffekts im Vorfluter),

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Darmstadt, West Germany.

Wasserwirtschaft, Vol. 68, No. 3, p 83-85, 1978. 3 fig, 1 tab, 8 ref.

The waste assimilative capacity of a river was found to be dependent upon both the attached organisms and suspended organisms residing in the water. On-site experiments were conducted to evaluate the contribution of attached organisms in the river self-purification process. The concept of the trickling filter was employed for the direct quantification of nutrient removal by attached organisms. The results of the study revealed that attached organism purification was responsible for 66-90% of the nutrient removal. The treatment ability of the attached organisms increased as the concentration and degradability decreased. The study verified the importance of bacterial slimes in the waste assimilative capacities of rivers.

H022
VIRUS ADSORPTION BY FIVE SOILS,

Burge, W. D., and Enkiri, N. K.

Agricultural and Environmental Quality Institute,
Agricultural Research Service--United States Department
of Agriculture,
Beltsville, Maryland.

Journal of Environmental Quality, Vol. 7, No. 1, p 73-76, 1978. 4 fig, 3 tab, 14 ref.

The Freundlich isotherm was applied to the adsorption kinetics of phi X-174 bacteriophage in five soil types with varying physical and chemical properties. Adsorption rates of 6 ml of the bacteriophage were observed in 6 g samples of Aastad clay loam, Kranzburg silt loam, Palouse silt loam, Parshall silt loam, and Quincy loamy sand. The Freundlich isotherm and adsorption rate constants and the optimum NaCl concentrations for virus adsorption were also calculated. The Quincy soil with a pH of 7.2 showed no adsorption of the virus, due possibly to its high organic content. Bacteriophage adsorption was represented as a function of the square root of time. The cation exchange capacity, specific surface area, and organic carbon content of the soil correlated with the virus adsorption rates of the four remaining soils. The influence of pH was found to be significant in the adsorption of the virus by the soil.

H023
NATURAL SEWAGE RECYCLING SYSTEMS,

Small, M. M.

1977. 40 p, 17 fig, 17 ref. NTIS Technical Report BNL-50630.

Natural purification of municipal waste waters was evaluated in experiments with marsh-pond systems at the Brookhaven National Laboratory in Upton, New York. Observations under identical conditions indicated that a marsh-pond system produced effluent of the same quality as a meadow-marsh-pond system but required about half the land area. Raw sewage mixed with septage was pretreated with degritting and aeration before application. The design of a marsh-pond sewage treatment system for a population of 2,500 and a waste flow of .25 mgd utilized a BOD curve to predict final effluent quality. A 24 hr aeration period reduced the initial 210 ppm BOD by 50%. A retention time of 18 days in the marsh further reduced the BOD to less than 30 ppm. Recharge of the waste water through a pine and deciduous forest floor produced a BOD of 5-15 ppm, resulting in a 98% BOD removal. Total nitrogen removal by the marsh-pond method with forest recharge was 87.5%. Costs for a marsh-pond treatment system of this scale, without land purchase costs or interest, were estimated to be $1/gal/day for initial expenses and $0.50/1,000 gal for operation and maintenance.

H024

ENVIRONMENTAL EFFECTS OF SEPTIC TANK SYSTEMS,

Scalf, M. R., Dunlap, W. J., and Kreissl, J. F.

Robert S. Kerr Environmental Research Laboratory,
Ground Water Research Branch,
Ada, Oklahoma.

1977. 42 p, 11 fig, 4 tab, 23 ref. Technical Report EPA-600/3-77-096.

On-site septic tank systems for disposal of domestic wastes were evaluated in terms of soil suitability, treatment efficiency, and health codes. Approximately one-third of the private homes in the United States depend upon on-site disposal systems, 85% of which are septic tank-soil disposal systems. An estimated 50% of these systems are located in soils not considered suitable to this type of disposal method. The potential for contamination of groundwater by septic tank-soil absorption systems is enhanced by: large densities of systems within one area; improper maintenance, construction, and design; and failure of these systems within the design life. Modifications to the septic tank system can increase efficiency, decrease potential groundwater contamination, and expand the applicability of a system. Land use planning and legislation are recommended to control the use and efficiency of septic tank-soil disposal systems. Research to modify and improve septic systems and alternative methods of domestic waste disposal are suggested.

H025

RATE OF AMMONIUM NITRIFICATION AND NITRATE LEACHING IN SOIL COLUMNS,

Corey, P. R., McWhorter, D. B., and Smith, J. L.

Colorado State University,
Fort Collins,
Department of Agricultural Engineering.

1976. 8 fig, 21 tab, 42 ref, 3 append. NTIS Technical Report NSF/RA-760505.

The rate of nitrification of ammonium, the leaching rate of nitrates through a saturated soil column, and the effect of aeration on nitrate leaching were observed in laboratory experiments to evaluate the impact of sewage sludge application to soils. Ammonium sulfate was applied to clay loam soil packed in 1.32 m columns; nitrate concentrations in the leachate from each column were measured. The nitrate leaching rate through the soil columns was calculated by the addition of sodium nitrate to the inflow water. The time required for nitrates to leach through the soil was significantly longer than the rate at which nitrification occurred. Nitrate leaching to a depth of 100 cm required a period five times longer than the time required for nitrification. In the clay loam soil, the seepage velocity was four times greater than the nitrate ion travel velocity. Water velocity was described as a function of inflow, saturated hydraulic conductivity, porosity, and a pore size distribution parameter. Unrealistic estimations of the parameters were required to predict the nitrate ion velocity through the soil column as a function of the water velocity equation.

H026
RECLAMATION OF WASTEWATER BY APPLICATION ON LAND,

Iskandar, I. K., and Leggett, D. C.

United States Cold Regions Research and Engineering
Laboratory,
Hanover, New Hampshire.

1976. 15 p, 5 fig, 2 tab, 23 ref. NTIS Technical Report AD/A-026-050.

Slow infiltration land application of primary and secondary waste water effluents to areas of sandy loam and silt loam was tested over a two-year period. The primary effluent contained 101 mg/liter BOD, 22.1 mg/liter ammonium-nitrogen, 0.6 mg/liter nitrate-nitrogen, 26.4 mg/liter total nitrogen, and 7.0 mg/liter total phosphorus. The secondary effluent contained 35 mg/liter BOD, 21.6 mg/liter ammonium-nitrogen, 2.4 mg/liter nitrate-nitrogen 26.9 mg/liter total nitrogen, and 7.1 mg/liter total phosphorus. Copper, zinc, chromium, nickel, lead, and mercury were added to simulate heavy metal concentrations in industrial wastes. Effluent was applied to six test cells by slow infiltration at rates of 5, 7.5, and 15 cm/wk. Percolates obtained from the test cells indicated that BOD was reduced to 0.6-2.1 mg/liter, ammonium-nitrogen lowered to 0-2.9 mg/liter, nitrate-nitrogen increased to 7.2-14.5 mg/liter, total nitrogen decreased to 8.1-16.3 mg/liter, and total phosphorus reduced to less than 0.5 mg/liter. Nearly all of the ammonium-nitrogen in the upper 45 cm of the test cells was converted to nitrate-nitrogen. Increases in total and extractable heavy metals were found in the soil and vegetation in the top 15 cm of the test cells. Extractable copper, cadmium, and nickel increased significantly with spiked sample application, especially in the silt loam test cells. The levels of these extractable metals were considered toxic.

H027
TRAVEL OF MICROORGANISMS FROM A SEPTIC TILE,

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Water, Air, and Soil Pollution, Vol. 9, No. 3, p 355-362, 1978. 4 fig, 3 tab, 11 ref.

The horizontal movement of indicator microorganisms from a septic tile drain in the direction of groundwater flow was significantly affected by soil saturation levels. Water samples were obtained over a two-day period from a 7.93 m-long test tile using 2 m boreholes located 0, 3.05, 6.10, 9.15, 12.20, and 15.25 m downslope from the end of the septic tile. The groundwater samples were analyzed for coliforms, fecal coliforms, and fecal streptococci. The concentrations of the bioindicators decreased with distance from the septic tile drain. The groundwater level, which generally varied from 0-3.05 m, was 0.15 m below the septic tile at a depth of 0.6 m during the sampling period. Significantly high concentrations of the indicator microorganisms were found at a distance of 15.25 m. These were attributed to the high saturation level which limited vertical gravitations and allowed horizontal travel of the bioindicators by the groundwater flow. Results indicated that a vertical distance of 1.22 m would require a horizontal separation of not less than 30 m between the septic tile and a water source in a shallow aquifer for adequate adsorption and filtration of sewage bacteria.

H028

MONITORING IN THE ZONE OF AERATION,

Morrison, R., and Bulot, M.

SCS Engineers,
Long Beach, California.

Public Works, Vol. 109, No. 4, p 64-65, April, 1978. 2 fig, 8 ref.

SCS Engineers of Long Beach, California, has developed pressure/vacuum lysimeters and moisture cells for detecting the infiltration of pollutants through the soil to the groundwater. The monitors are installed above the water table, in the aeration of vadose zone, to trace the path of leachates carried via interstitial water from waste disposal sites. The 3 ft-long polyvinyl chloride lysimeter has a porous ceramic cup at one end to filter elements of the leachate. Two polyethylene tubes mounted in a rubber stopper at the other end of the lysimeter are used to collect the water sample and pressurize and evacuate the tube. Although they cannot provide water samples for subsequent analysis, moisture cells can yield information on the amount of soil water present with respect to established background levels. In the moisture cell, two plates are separated by a processed fiberglass binding which expands or contracts with respect to variations in the soil interstitial moisture content. Moisture cells can be used to detect infiltration to the aeration zone beneath lined waste disposal lagoons located in areas for which the field capacity is known.

H029

RECYCLING OF WATER FOR IRRIGATION: PERSISTENCE OF ENTEROVIRUSES IN SEWAGE EFFLUENT AND NATURAL WATERS RECEIVING THE EFFLUENT,

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Honolulu,
Water Resources Research Center.

Water, Air, and Soil Pollution, Vol. 9, No. 2, p 213-226, 1978. 5 tab, 21 ref.

Human enteroviruses were isolated in raw sewage, activated sludge, and chlorinated effluent from an Oahu treatment plant used to irrigate a two-year sugarcane crop, and in several samples from streams and Pearl Harbor, Hawaii. The sewage samples were concentrated by polyelectrolyte 60 (PE-60), polymer two-phase, aluminum hydroxide, and protamine sulfate methods of enterovirus adsorption. Viruses were recovered from samples of river and harbor water by filtration through a cellulose membrane. Concentration of the chlorinated effluent yielded a 36% virus recovery by the PE-60, 68% by the polymer, 44% by aluminum hydroxide, and 3% by the protamine sulfate. The cellulose membrane recovered 38% of the enterovirus from receiving waters. The removal percentages from the samples were relatively high, although recovery rates were less efficient. Other viruses isolated in the waste water effluent included: coxsackievirus B-4, and B-5; echovirus-1, 7, and 27; reovirus; and poliovirus-1, 2, and 3. Poliovirus strains 1 and 3 were isolated in the water samples from the streams and harbor. Although the treatment methods at the Oahu plant removed about 90% of the human enteric viruses from the wastes, infectious viruses were still evident in the treated effluent and receiving waters.

H030

AQUEOUS RELEASE OF HEAVY METALS FROM TWO SEWAGE SLUDGES,

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West Virginia University,
Morgantown,
United States Department of Agriculture-Agricultural Research
Service, Division of Plant Sciences.

Water, Air, and Soil Pollution, Vol. 8, No. 4, p 453-459, 1977. 3 tab, 12 ref.

Since heavy metals in land-applied sludge pose a potential threat to the ecosystem, experiments were performed to investigate the quantity of cationic and non-cationic copper, zinc and cadmium released into water extractions from a primarily domestic waste sludge and an industrial waste-dominated sludge. Five aqueous extracts, simulating conditions immediately following land disposal of sludge, were obtained from both of the anaerobically-digested sludges. In the domestic sludge, the initial aqueous extraction removed 89.7% of the water soluble copper, 95.9% of which was cationic; the five combined extractions recovered 6.9% of the total copper. The five combined extractions recovered 4.38% of the total zinc, with the cationic zinc decreasing in successive extractions. Cadmium was initially released into the sludge supernatant, with a total of 0.89% of the total cadmium and 43.8% of the cationic cadmium released in the five extractions. In the industrial dominant sludges, 4.30% of the total digestible copper was released over five extractions, with 63.2% as cationic copper. An average of 2.79% of the total zinc was recovered in the five aqueous extractions, 99.5% of which was in the cationic form. The aqueous phase contained 1.04% of the total cadmium from the sludge and 100% of the cationic cadmium. Copper and zinc were extracted more readily from the domestic sludge than from the industrial sludge, while the opposite was true for cadmium.

H031

INFECTIOUS DISEASE HAZARDS OF LANDSPREADING SEWAGE WASTES,

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Agriculture Environmental Quality Institute,
Agricultural Research Service-United States Department of Agriculture,
Beltsville, Maryland.

Journal of Environmental Quality, Vol. 7, No. 1, p 1-9, January-March, 1978.
3 tab.

Human diseases associated with land application of sludge, pathogen movement, pathogen viability, and disinfection are discussed in a literature review. Common infectious pathogens found in sewage include bacteria, protozoa, helminthic parasites, and viruses. Outbreaks of the diseases associated with forms of these pathogens have been directly traced to irrigation practices of sewage sludge, domestic wastes, and treated waste water disposal. Contamination of water supplies and consumption of raw vegetables and shellfish grown in the presence of sewage are the major means of transfer of sewage-related diseases to humans. Effects of sewage-borne pathogens on irrigation and treatment plant operators have been negligible. Percolation of waste water through certain soil types can remove amoeba cysts, helminth ova, and some bacteria and viruses; surface runoff of waste water poses a potential hazard. Heat drying, liming, composting, irradiation, and pasteurization have been found to be more effective than chlorination in pathogen removal. Pathogen-bearing aerosols from sprinkler irrigation of waste water can be reduced by modification of irrigation equipment and by establishment of a buffer zone of trees and shrubs.

H032
RIVER WATER QUALITY IN ESSEX DURING AND AFTER THE 1976 DROUGHT,

Slack, J. G.

Essex Water Company,
England.

Effluent and Water Treatment Journal, Vol. 17, No. 11, p 575-578, November, 1977. 2 fig, 3 tab, 2 ref.

The impact of a 1976 drought on the water quality of sewage receiving rivers in Essex, England, was analyzed. River flows in the River Stour in July averaged 2.64 mgd, nearly the total quantity of sewage discharged to the river; the River Chelmer averaged 4.98 mgd, half of which consisted of sewage effluent. Sewage effluent in the rivers was monitored with boron measurements, an element that is not found naturally in river water. The concentration of chloride, discharged into the Stour at the rate of 7.000-8,000 lbs/day, downriver from the outlet source was much lower than expected during the very dry summer months. Similarly, nitrate in the sewage effluent, averaging 20 mg/liter, was reduced to one-tenth the initial concentration in the downstream river water, indicating biological denitrification. Nitrate and chloride concentrations increased significantly in the fall when rainfall increased. It was concluded that chloride and other sewage effluent constituents accumulated in the river beds during low flow periods and were washed from the bed with the increasing volume of clean water from rainfall; biological denitrification also increased during the low flow periods.

H033
THE MOVEMENT OF SEWAGE EFFLUENT THROUGH SOIL COLUMNS: THE MAJOR IONS (NA, CA, MG, CL, AND SO4),

De Jong, E.

Saskatchewan University,
Saskatoon, Canada,
Department of Soil Science.

Journal of Environmental Quality, Vol. 7, No. 1, p 133-136, January-March, 1978. 5 fig, 4 tab, 13 ref.

Laboratory experiments investigated the leaching of sodium, calcium, magnesium, chloride, sulfate, and potassium contained in sewage effluent through soil columns. One liter of sewage effluent contained 236 mg sodium, 19.6 mg potassium, 87 mg calcium, 53 mg magnesium, 204 mg chloride, and 387 mg sulfate. The effluent was introduced into the columns packed with 3 horizons of Asquith loamy sand and 1 horizon of Oxbow clay as flood or trickle flow at 7, 13, and 18 C under dark conditions. The passage of sodium, calcium, magnesium, chloride, and sulfate ions was not significantly altered by temperature, soil structure, or application. Breakthrough curves demonstrated more rapid passage of the anions through the columns than predicted. This behavior was attributed to incomplete mixing of the effluent and soil. The passage of sodium, calcium, and magnesium was affected by exchange reactions; sodium and calcium approached equilibrium after 3 pore volumes leached, much sooner than magnesium. Cation breakthrough curves were altered by incomplete mixing, initial exchangeable and soluble cation concentrations, and the sum of the exchangeable cations.

H034
WASTEWATER RENOVATION BY A PROTOTYPE SLOW INFILTRATION LAND TREATMENT SYSTEM,

Iskandar, I. K., Sletten, R. S., Leggett, D. C., and
Jenkins, T. F.

United States Army Cold Regions Research and Engineering
Laboratory,
Hanover, New Hampshire.

1976. 51 p, 23 fig, 10 tab, 63 ref, 1 append. NTIS Technical Report
AD-A029-744.

Six experimental sand loam and silt loam test cells at the United States Cold Regions Research and Engineering Laboratory in New Hampshire were spray irrigated with ozonated primary and secondary effluent for a one year period. The program's objective was to evaluate the effectiveness of waste water purification by slow land infiltration. Nitrogen, chloride, and suspended solids levels in the waste water varied with seasonal conditions; BOD, fecal coliforms, and organic carbon were reduced by secondary treatment with extended aeration. The application of 628-2055 kg/hectare total nitrogen, 85% of which was ammonia, to the soil cells over the one year period revealed that nitrogen was converted to nitrate-nitrogen in the top 45 cm of the soil. The concentration of nitrate in the soil percolates peaked at 125 mg/liter nitrate-nitrogen during the summer months and averaged 10 mg/liter during other periods. Ammonia-nitrogen leached through the soil cells only during winter months. A total nitrogen uptake of 26-54% by the forage grown on the soil cells was reported. The test cells removed 99% of the total phosphorus, averaging 7.0 and 7.1 mg/liter in the primary and secondary effluent, respectively. The test cells completely removed BOD, suspended solids, fecal coliform, and organic carbon.

H035

SPRAY IRRIGATION OF DOMESTIC SEWAGE IN THE BRAUNSCHWEIG SEWAGE ASSOCIATION - ENVIRONMENTAL POLLUTION OF SUCCESSFUL UTILIZATION OF SEWAGE? (Die Verregnung von kommunalem Abwaessern im Abwasserverband Braunschweig - Umweltverschmutzung oder sinnvolle Abwasserverwertung?),

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Wasser und Boden, Vol. 30, No. 3, p 63-67, 1978. 8 fig, 4 tab, 10 ref.

The Braunschweig Sewage Association in West Germany performed tests on a 4,000 ha plot of brown podsol agricultural land to determine the extent of groundwater contamination by spray irrigation with municipal waste water. Water and soil analyses were also used to define the waste assimilative capacity of the soil. Permanganate consumption and BOD values disclosed that almost no organic substances in the spray-irrigated effluent reached the groundwater. Soil water analyses following a single application of excessive quantities (5,400 mm/ha) of municipal sewage by spray irrigation revealed that although the groundwater was contaminated at the irrigation site, only elevated nitrate levels were apparent after 350 m of transport from the site. Repeated applications of effluent reduced the waste assimilative capacity of the soil, especially during winter months when vegetation was not extensive. Effluent applications did leach sodium, potassium, and nitrate ions from the large quantities of synthetic fertilizers which had been applied to the area. This phenomenon was considered an important consideration in assessing the nutrient levels provided by spray irrigation.

H036

A SHORT TERM STUDY ON THE POLLUTION OF TAPTI RIVER IN SURAT REGION,

Shelat, R. N., Vashi, N. V., and Subbayya, N. V.

Journal of the Institution of Engineers (India), Vol. 58, Part EN 1, p 25-28, October, 1977. 5 fig, 1 tab, 4 ref.

Physical and chemical water quality parameters were recorded at 10 sampling stations along a 16-km portion of the Tapti River in the Surat region of India. Pollution sources along the river included a paper mill, a thermal power plant, municipal sewage, domestic sewage, and textile wastes. The pH of the river samples ranged from 6-8 with a temperature of 20-24 C. Other chemical parameter ranges included: 24-54 mg/liter chlorides, 17-52 mg/liter sulfates, 6.2-8.4 mg/liter dissolved oxygen, 40-280 mg/liter BOD, and 89-512 mg/liter COD. Total solids ranged from 48-344 mg/liter with suspended solid loads of 42-269 mg/liter. While the physical properties of the river water did not exceed Indian water quality standards, BOD values were higher than allowed at all sampling sites; chlorides exceeded standards near the municipal storm water outlet to the river. The pollutant levels were lower during the winter months.

H037

THE APPLICATION OF A TIME-SERIES-ANALYSIS IN WATER QUALITY MANAGEMENT (Anwendung einer Zeitreihenanalyse in der Wasserguetewirtschaft),

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Wasser und Boden, Vol. 30, No. 3, p 50-54, 1978. 8 fig, 8 ref.

Spectral and Fourier analysis constitute important tools for the description of time series in water quality management. A calculated time series function can be extrapolated to predict changes in water quality. The difference between measured water quality indicators, such as oxygen content and chloride levels, and the extrapolated values can be used to quantify the environmental impact of external factors, such as the construction of a sewage treatment plant or the addition of a new industrial source of pollution. The procedure is used in an example involving water quality data for the Oker River and its tributaries, collected for the years 1965-1973 by the Institute for Urban Studies of the Technical University in Braunschweig, West Germany. Equations expressing the trend and periodicity functions are derived; time series analysis is used to predict the Oker River quality on the basis of trends in dissolved oxygen and chlorine levels.

H038

PROBLEMS AND TECHNIQUES FOR THE AERATION SYSTEMS IN SEWAGE WORKS AND SURFACE WATERS--EXPERIENCE WITH INSTREAM AERATION AND OXYGEN MONITORING IN THE RIVER RUHR,

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Essen, West Germany.

Tribune du CEBEDEAU, Vol. 30, No. 409, p 449-456, December, 1977. 13 fig, 7 ref.

Instream aeration of the Ruhr River in West Germany has been conducted since 1965 to compensate for oxygen deficiencies during summer months due to the decomposition of dead algae. The Ruhr, with average flows of 75 cu m/sec, sustains low flows of 3-5 cu m/sec over an average of 120 days annually. The water flow is augmented by reservoir water during these periods. The Ruhr also receives treated waste water which comprises up to 36% of the total flow during low flow conditions. Four impounding lakes, providing further treatment of municipal effluent and storm water overflows, reduce effluent BOD from 5.5 to 4.8 mg/liter. Chlorophyll-a algal blooms during summer months depress dissolved oxygen levels to as low as 2 mg/liter; high chlorophyll-a concentrations have resulted in oxygen supersaturation followed by dissolved oxygen depression, a situation leading to fishkill. During 1971-1975, five oxygen monitors were installed along the Ruhr above an instream aeration system which includes: a 47 kg 02/hr floating aerator, a 178 kg 02/hr aerator, two weirs, and a bypass stream. The instream aeration system is activated when the oxygen monitors detect dissolved oxygen concentrations below 4 mg/liter in the upstream waters. Compressed air was found to be more economical than pure oxygen aeration.

H039

RESULTS OF POLLUTION CONTROL OF THE RHINE WATER IN RHINE-LAND-PALATINATE
(Erfolge bei der Reinhaltung des Rheins in Rheinland-Pfalz),

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Mainz, West Germany.

Wasserwirtschaft, Vol. 67, No. 11, p 348-352, 1977. 7 fig, 1 tab.

Pollution parameters in the Rhineland-Palatinate area of the Rhine River were measured by the West German Hydrologic State Office. The pollution load on the Rhine has been reduced by 90% since 1974, representing a population equivalent of 1.16 million. Water quality parameters measured during the study included BOD, dissolved oxygen, ammonia, chromium, and saprobidity. The pollution load on the Rhine, reduced by 650,000 population equivalents in 1976, was higher in that year than in the previous year due to a 56% increase in runoff. The pollution load was lower within the first 4 mos of 1977 than during 1975 and 1976. The study verified that the water quality of the Rhine since has improved significantly as a result of pollutant load reductions.

H040

CONTROLLING IMPOUNDMENTS WHICH MAY POLLUTE GROUNDWATER,

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Water and Sewage Works, Vol. 125, No. 1, p 62-64, 66-67, January, 1978.

Problems associated with groundwater contamination by impoundments storing municipal and industrial wastes are reviewed. A leak in one of two oxidation lagoons, lined with reinforced rubber on tar-impregnated fiber mats on top of rock, was undetected by a water level counter and was found only when lagoons were drained. Leakage from sewage oxidation lagoons, occupying 180 acres and receiving municipal wastes and sodium chloride pickling brine, contaminated groundwater within a 1,000 ft zone with chloride levels up to 220 mg/liter. Chloride levels near the pickling plants ranged up to 1,690 mg/liter in domestic drinking wells and 6,300 mg/liter in a plant well. Chloride was found at a depth of 75 ft, 400 ft from brine and pickling tanks. Leakage in two covered, polyvinyl chloride membrane-lined storage lagoons for liquid nitrogen increased nitrate-nitrogen concentrations to as high as 27 mg/liter at a distance 50 ft from the ponds. Plating waste leakage from a storage lagoon contaminated water 1000 ft from the site to a depth of 50 ft. Groundwater was not contaminated; chromium and other metals had coated sand, silt, and clay horizons at a depth between 20-45 ft. Phenolic wastes stored in a clay-lined lagoon leaked to a depth of 9 ft, producing stream and groundwater phenol concentrations of 2.1 mg/liter and 14.4 mg/liter, respectively.

H041

APPLICATION OF DIGESTED SLUDGE FOR IMPROVING ERODED SOIL CAUSED BY SO2,

Wong, M. H., and Yip, S. W.

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Shatin,
Department of Biology.

Journal of Environmental Sciences and Health, Vol. A13, No. 1, p 23-31, 1978.
4 tab, 15 ref.

Soils degraded by SO2 emissions from an acid manufacturing plant were conditioned with digested sewage sludge and planted with Agropyron smithii and Buchole dactyloides in a greenhouse trial test. The grasses were grown in: untreated SO2-degraded red-yellow podzol soil; degraded soil treated with 0.5, 1.0, and 1.5 cm digested sludge; and garden soil. The digested sludge had 29.02% organic carbon, 1.96 ppm phosphorus, 41 ppm exchangeable potassium, and a pH of 6.68; the eroded soil contained 1.30% organic carbon, 0.02 ppm phosphorus, and 2.4 ppm exchangeable potassium and had a pH of 4.7. A. smithii and B. dactyloides were grown for 80 days and then harvested. A. smithii cultivated in SO2-degraded soil with sludge applications of 0.5, 1.0, and 1.5 cm grew to heights of roughly 12.55, 15.17, and 17.77 cm/pot, respectively; the untreated SO2-degraded soil and the garden soil yielded growth of 2.12 and 38.25 cm/pot, respectively. B. dactyloides had heights of about 4.76, 9.07, and 14.50 cm/pot in the sludge amended soil; heights of 1.50 and 25.65 cm/pot were attained in the untreated soil and the garden soil, respectively. Grasses grown in the digested sludge treated soil were immature in comparison with the garden soil grown plants, but demonstrated improved growth over those grown in the untreated SO2-degraded sludge. Extractable zinc levels in the sludge were in excess of English agricultural standards.

H042

TEHRAN GROUND WATER POLLUTION BY DETERGENTS,

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School of Public Health and Institute of Public Health Research,
Iran,
Department of Environmental Health.

Water, Air, and Soil Pollution, Vol. 9, No. 1, p 119-122, January, 1978. 2 fig, 3 ref.

Detergent concentrations in groundwater aquifers were analyzed in 316 wells with depths ranging from 8-330 m in Tehran, Iran. Samples were analyzed by the methylene blue colorimetric technique; calibration curves were calculated by the least squares method. Detergent concentrations in samples collected over a 10-mo period ranged from traces to 1.403 mg/liter. The average concentration of detergents, within a confidence limit of 95% and a permissible error of ± 0.005, was calculated at 0.1163-0.1593 mg/liter as methylene blue active substance. The United States and the World Health Organization permit detergent concentrations of 0.5-1.0 ppm in drinking water, below Tehran sampled concentrations. An isoconcentration map of detergent concentration distribution revealed localization in industrial and urban areas.

H043

THE EFFECTS OF MADISON METROPOLITAN WASTEWATER EFFLUENT ON WATER QUALITY IN BADFISH CREEK, YAHARA AND ROCK RIVERS,

Lee, G. F.

Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. 65, p 163-179, 1977. 3 fig, 1 tab, 14 ref.

The impact of diverting the flow of treated effluent from the Madison Metropolitan Sewerage District's Nine Springs Sewage Treatment Plant in Wisconsin to the Badfish Creek was examined. A $3.5 million pipeline was constructed to divert effluent flows to Badfish Creek rather than the Yahara and Rock Rivers, which flow into Lakes Waubesa and Kegonsa where excessive amounts of algae were growing. Activated sludge, trickling filters, and chlorination are employed by the plant before effluent is discharged to the diversion ditch leading to the creek. Flows measured over the period from 1952-1970 ranged from a low of 16.2 mgd in 1953 to a high of 31.3 mgd in 1970; BOD ranged 16-47 mg/liter and suspended solids ranged 15-52 mg/liter. The higher pollutant concentrations occurred during 1961-1963 when the treatment facility was undergoing construction. Water samples from 12 stations on the Badfish Creek and the Yahara and Rock Rivers were analyzed for BOD, suspended solids, total and soluble P, nitrates, nitrites, ammonium, and organic nitrogen. Inorganic nitrogen and orthophosphate concentrations in the Yahara River just below the point where Badfish Creek enters have increased since effluent has been diverted. Nutrient levels in the Rock River below the Yahara River junction have also increased. This increase in orthophosphate has been partially attributed to increased loads of phosphorus on the treatment plant. Dissolved oxygen levels at the first sampling station on Badfish Creek often dropped below 3 mg/liter; dissolved oxygen levels at stations on the lower Yahara River were usually above the critical level.

H044

RECLAMATION OF ACIDIC DREDGE SOILS WITH SEWAGE SLUDGE AND LIME AT THE CHESAPEAKE AND DELAWARE CANAL,

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United States Army Cold Regions and Research and Engineering Laboratory,
Hanover, New Hampshire.

1977. 28 p, 6 fig, 9 tab, 29 ref. NTIS Technical Report AD-A041636.

The impact of sewage sludge and lime enrichment of pyritic, acidic dredge soils from the Chesapeake and Delaware Canal was investigated in field studies examining the growth of 29 grasses on the reclaimed soils. A 17-acre area was treated with 45 tons/acre sewage sludge and 10 tons/acre lime applied to a depth of 8 inches. Soil samples at depths of 0-8, 8-16, and 16-24 inches were obtained 20 months after sewage sludge and lime application. The upper soil layer sample had higher pH, cation exchange, exchangeable Ca and Mg, organic C, and P levels when compared to untreated control areas. Total and extractable metals also increased within the 0-8 inch depth. Parameters measured in the lower strata were similar in the control area; Ca and Mg levels were elevated in the lower layer samples. Most of the Zn, Cr, Pb, and Hg was not in a plant-available form; 50% of the Ni and Cd were available to plants and extractable at a concentration of 30.2 ppm. Good growth was observed in Kentucky bluegrass, red fescue, and K-31 tall fescue; the dense groundcover growth of ryegrass hindered the growth of other perennial grasses. Of the seven plant species analyzed for mineral uptake, two types contained Ni concentrations approaching toxicity.

H045

SOME FACTORS AFFECTING DENITRIFICATION IN SOILS IRRIGATED WITH WASTEWATER,

Barr, S. S., Miller, R. H., and Logan, J. T.

Ohio State University,
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Department of Agronomy.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 709-717, April, 1978. 6 fig, 5 tab, 17 ref.

Biological denitrification was investigated at soil sites irrigated with waste water by the Pennsylvania State University waste water management project. The three clay loam soil sites included a plot of reed canarygrass, a hardwood forest, and an abandoned field; the fourth mixed hardwood site was formerly designated as gameland and consisted of loamy sand. The sites had been spray irrigated with waste water since 1963; untreated control sites were also maintained and soil samples were collected at various depths four times in two years. The top 7.5 cm of the treated soil sites contained the highest organic carbon and total nitrogen levels, and carbon/nitrogen ratios. All soils and vegetation exhibited low denitrification potentials attributed to a shortage of available organic carbon. This assumption was supported when denitrification increased after glucose was added to the soils as a carbon source. Carbon supplements added in the form of plant residues in the wastewater could not support denitrification below the 15 cm root zone, indicating that excess nitrate would leach into the groundwater. Reducing nitrogen levels in the waste water and increasing carbon sources during periods when crops were not grown was recommended.

H046

MODELLING AND OPERATIONAL CONTROL OF WATER QUALITY IN RIVER SYSTEMS,

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Center for Resource and Environmental Studies.

Water Research, Vol. 12, No. 6, p 377-384, 1978. 9 fig, 14 ref.

BOD, dissolved oxygen (DO) and nitrogen models developed for the English Bedford-Ouse River System were applied to the control of instream aeration and nutrient levels. A basic differential mass balance was transformed into a discrete-time model incorporating two coupled first-order equations to describe BOD and DO at the output of a specific reach in a non-tidal river. The ratios of BOD and DO to the oxygen absorption potential at the output of the reach were expressed as a function of the volumetric flow rate in the stream, the volumetric hold-up of the reach, the upstream BOD or DO input, factors in algal growth, and a series of time-invarient coefficients. Reaeration rates, which can lead to low dissolved oxygen calculations in winter months, could be incorporated into the model as coefficients determined from the volumetric flow rate and the river depth. Instream aeration to raise the DO concentration near sewage effluent outfalls could be controlled by locating DO probes downstream and upstream of the outfall. The models could be used to control instream aeration by incorporating coefficients to influence DO probe signals and prevent deviation from the desired DO level. The artificial aeration control model was applied to the River Cam; nutrient levels in the Bedford-Ouse were predicted with previously developed models.

H047
INDUSTRIALIZATION AND RIVER ECOLOGY,

Chaturvedi, A. C.

Uttar Pradesh Irrigation Commission,
Lucknow, India.

Journal of the Institution of Engineers (India), Vol. 58, No. 2, p 38-41, February, 1978.

The physical, chemical, and hydraulic characteristics of eight Indian rivers receiving municipal and industrial effluents were investigated by on-site analysis and model studies. Transport equations for the dilution characteristics of the discharged effluents incorporated the balance of convection, turbulent diffusion, production, and dissipation; the rate of dispersion of industrial effluents was dependent upon the transverse mixing. The model contained equations for depth, average velocity, and concentration; rapid vertical mixing of the effluents was observed. Analytical data from the 25 sampling sites was relayed by telemetry to a computer for storage. Discharge velocities from the effluent outfalls had a greater influence on the discharge width; downstream channel flow directly affected dispersion. Artificial destratification to improve water quality by increasing the exchange in the vertical direction was rejected because of adverse temperature disruption; instream oxygenation was considered feasible for improving water quality. Laboratory-scale aeration tanks revealed that a 50% increase in salinity in waste water would destroy ether-soluble bacteria; phenol concentrations increased to 400 mg/liter, causing overloading. When operated at 25-33% salinity, sludge wastage at a rate of 0.5 liters/day was required.

H048
RECOVERY OF TWO POLLUTED RIVERS,

Best, G. A.

Effluent and Water Treatment Journal, Vol. 18, No. 6, p 267-271, 273, June, 1978. 4 fig, 5 tab, 2 ref.

The quality of two Scottish rivers, Black Cart Water and Levern Water, was increased by improved sewage treatment and by the termination of some industrial waste discharges. Effluent quality improved significantly when the Johnstone sewage treatment works was completed in July, 1976. Black Cart Water, the receiving body for the effluent, was continuously monitored according to Chemical Quality Index (CQI) and Biotic Index (BI). The CQI, derived from BOD, suspended solids, ammonia, and dissolved oxygen concentrations, increased to 9 on a 1-10 scale for both upstream and downstream waters, within 9 mos after the plant was operational. The BI of the river, derived from aquatic invertebrate studies, improved more slowly due to the slow recolonization by clean water organisms. Construction of the Neilston sewage treatment plant and closure of the overloaded Barrhead plant improved the quality of the Levern Water. The CQI of the river in the vicinity of Neilston had improved to 9 both upstream and downstream within 4 mos of initiation of the activated sludge plant operation; downstream water quality had been as low as 3. The CQI in the Barrhead area of Levern Water increased to 8 from a low of 1 downstream and 6 upstream. Biological recovery was retarded by periodic tannery waste discharges and slow recolonization of the benthic substrate.

H049
ORGANIC ASSIMILATION CAPACITY OF MAUMEE RIVER ESTUARY AT TOLEDO, OHIO,

Kunkle, G. R., and Wordelman, S. L.

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Toledo, Ohio.

Journal Water Pollution Control Federation, Vol. 50, No. 5, p 957-969, May, 1978. 11 fig, 4 tab, 13 ref.

The Storm Water Management Model (SWMM) and a streamwater quality budget model evaluated the organic waste assimilative capacity of the Maumee River estuary at Toledo, Ohio. A total annual BOD load of 5,485,900 kg, calculated by SWMM, flows into the Maumee River through combined and separated sewers, industrial discharges, the Bay View Water Reclamation plant, abnormal bypasses of overflows, and Swan Creek. A water quality monitoring station on the river has detected vertical stratification of dissolved oxygen during the summer months; the dissolved oxygen flowing load deficit between the months of June and October ranged over 3,000-9,300 kg/day. The streamwater budget model for determining the assimilative capacity of the river calculated the net and gross dissolved oxygen concentrations, the upstream and local BOD flushed, the benthic BOD deposited and exerted, the gross oxygen demand, and the changes in dissolved oxygen storage. The annual average dissolved oxygen supply of 33,200 kg/day and the gross oxygen demand of 33,100 kg/day represented a 100 kg/day dissolved oxygen storage change. The assimilative capacity of the Maumee River during the summer months varied over 7,800-27,100 kg/day, requiring an instream oxygen demand reduction ranging from 7,300-16,000 kg/day. It was concluded that if all local BOD discharges to the river were eliminated, the dissolved oxygen concentration would still be below 4.0-5.0 mg/liter dissolved oxygen standard set by Ohio.

H050

SURVEY OF HUMAN VIRUS OCCURRENCE IN WASTEWATER-RECHARGED GROUNDWATER ON LONG ISLAND,

Vaughn, J. M., Landry, E. F., Baranosky, L. J., Beckwith, C. A., and Dahl, M. C.

Brookhaven National Laboratory,
Department of Energy and Environment,
Upton, New York.

Applied and Environmental Microbiology, Vol. 36, No. 1, p 47-51, July, 1978.
9 tab, 22 ref.

Three waste water recharge facilities on Long Island, New York, were monitored in a 1-yr study to assess the transfer of human enteroviruses and coliforms into groundwater. Effluent samples from all three plants were collected monthly and observation wells were drilled below the recharge sites. Total coliform counts in groundwater near a facility recharging chlorinated trickling filter effluent 30 ft above the aquifer ranged over 15-23,000/100 ml; enterovirus isolation ranged over 0-3.6 plaque-forming units/gal. Viruses isolated in the effluent included echo-, coxsackie-, and poliovirus types; the groundwater contained echovirus type 12 and other unidentified viruses. Chlorinated effluent was recharged 80 ft above the water table in another facility; groundwater samples yielded no viruses and 4-23,000 coliforms/100 ml. The results indicated that viruses were unable to reach the depth of the aquifer. Total coliforms in groundwater from a facility discharging tertiary effluent to a basin 18 ft above the aquifer ranged over 4-930 coliforms/100 ml; virus levels ranged over 0-10.6 plaque-forming units/gal. Viruses isolated in groundwater at this site included echoviruses types 6, 21, 24, 25, and several unidentified types; both vertical penetration and horizontal movement of the viruses through the aquifer were indicated by their presence in the observation well located 50 yds from the recharge site.

H051

NITRIFICATION AND OTHER FACTORS AFFECTING NITROGEN IN THE HOLSTON RIVER,

Ruane, R. J., and Krenkel, P. A.

Tennessee Valley Authority,
Chattanooga.

Journal Water Pollution Control Federation, Vol. 50, No. 8, p 2016-2028, August, 1978. 8 fig, 3 tab, 41 ref.

Recent studies measured nitrification and denitrification in the Holston River near Kingsport, Tennessee; factors influencing these processes and the impact of nitrogen on the Cherokee Reservoir near Jefferson City were also evaluated. Along the 151.3 km stretch of the river studied, total nitrogen inputs to the river included 82 kg/day by a sewage treatment plant, 27 kg/day by a paper mill, 2,497 kg/day by an ammunition plant, and 7,312 kg/day by a chemical plant. Dissolved oxygen, pH, temperature, benthic oxygen demand, and standing crops of attached aquatic plants were measured in river samples; the rates of change in ammonia, nitrate, and nitrite levels within the various stream reaches were used to calculate the oxidation rate for nitrogenous BOD. Significant nitrification did not occur until river mile 137.9 and was attributed to nitrifying bacteria requiring up to 10 days to generate; denitrification occurred in the upstream reaches where nitrifiers were absent. The point of observed nitrification, occurring after about 0.2 days, corresponded to the critical dissolved oxygen sag. Oxygen depletion in the Cherokee Reservoir was dependent upon influent oxygen demand, decomposition of aquatic weeds, ammonia regeneration by zooplankton, fish excretions, and overall biological respiration.

H052

THE EFFECT OF WASTE WATER REUSE IN COLD REGIONS ON LAND TREATMENT SYSTEMS,

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Laboratory,
Hanover, New Hampshire.

Journal of Environmental Quality, Vol. 7, No. 3, p 361-368, July-September, 1978. 5 fig, 5 tab, 26 ref.

The impact of land application of primary and secondary effluent on groundwater quality, soils, and vegetation in cold climates was investigated over a 2-yr period at the Army's Cold Regions Laboratory in Hanover, New Hampshire. Three cells containing Windsor sandy loam and three containing Charlton silt loam with depths of 150 cm were established; for a 1-yr period, two sandy loam cells received 5 and 15 cm/wk secondary effluent and one silt loam cell received 5 cm/wk. The other test cells received 7.5 cm/wk primary effluent. Vegetation, primarily quackgrass, was harvested six times over the two-year period. Test cell leachate for the 1-yr period contained 8.1-16.3 mg/liter total nitrogen, <0.5 mg/liter total phosphorus, 8.5-10.3 mg/liter organic carbon, 0.6-2.1 mg/liter BOD, and 21.9-28.0 mg/liter chloride. High nitrate concentrations in the leachate during early summer were attributed to oxidation of ammonia stored in the soils during winter months; the ammonia was oxidized to nitrate within the top 45 cm of the soil. Nitrogen removal was primarily by plant growth and percolation. Effluent application at a rate of 15 cm/wk to one test cell consistently produced a leachate containing an excess of nitrate-nitrogen for 9 mos of the year. Heavy metals were confined primarily to the top 15 cm of soil; leaching below this level was attributed to a decrease in soil pH.

H053

ELIMINATION OF FECAL COLIFORM BACTERIA FROM SOIL IRRIGATED WITH MUNICIPAL SEWAGE LAGOON EFFLUENT,

Bell, R. G., and Bole, J. B.

Singapore University,
Singapore,
Department of Microbiology.

Journal of Environmental Quality, Vol. 7, No. 2, p 193-196, April-June, 1978.
3 tab, 17 ref.

Sewage lagoon effluent was applied by spray irrigation at a rate of about 4.5 cm/week to two Brown Cavendish loamy soil plots planted with reed canarygrass. The study was performed to examine the distribution and viability of fecal coliforms in the soil. Soil samples to a depth of 130 cm were collected weekly; fecal coliforms were enumerated after the first vegetation cutting, after the second cutting, and after a single fall irrigation. Coliforms never moved below a depth of 69 cm and were concentrated primarily within the top 8 cm of the soil. The initial 48 hrs after irrigation yielded a die-off rate of about 90%. The remaining 10% of the coliforms were diminished at a much slower rate over a period of about 2 weeks in the planted plots. Fecal coliform populations in the soil irrigated once after canarygrass harvesting remained detectable for 8 wks; the death rates of the coliforms doubled for each 10 C increase in temperature.

H054

THE IMPACT OF SUBTIDAL SEWAGE OUTFALLS ON THE INTERTIDAL MACROFAUNA OF SEVERAL CENTRAL PUGET SOUND BEACHES,

Armstrong, J. W.

Dissertation Abstracts International B, Vol. 39, No. 2, p 527-528, 1978.

The intertidal macrofauna were surveyed over a 21-mo period at five beaches located near municipal outfall sewers in Puget Sound, Washington. The 80 sites, sampled every three months, were characterized by fine-grained wave-rippled sand or cobble-strewn mixed sediments. Sampling yielded 302 species of intertidal invertebrates and fish; infauna and epifauna were screened from sediment samples. The control beach and the beach considered most likely to be affected by the outfall discharges yielded the highest number of species; 10-15% fewer species were obtained from the other sites. Substrate type rather than the extent of pollution controlled the degree of species differentiation; benthic faunal diversity was greater in individual samples than the variability between different beach samples. Saxidomus giganteus and Macoma inquinata collected at the beach most likely to be affected by outfall discharges did not exhibit deteriorated bivalve condition index values; growth rates of Hemigrapsus oregonenesis and S. giganteus were not substantially different from those at other beaches. Although several species of pollution-indicating polychaete feeding types were collected at all beach sites, the proportions were similar at all beaches and not considered to be related to waste disposal. Stepwise discriminant analyses yielded no pollution-related gradients; benthic faunal variations were primarily dependent upon sediment type.

H055

POLIOVIRUS REMOVAL FROM PRIMARY AND SECONDARY SEWAGE EFFLUENT BY SOIL FILTRATION,

Gerba, C. P., and Lance, J. C.

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Houston, Texas,
Department of Virology and Epidemiology.

Applied and Environmental Microbiology, Vol. 36, No. 2, p 247-251, August, 1978. 2 fig, 3 tab, 22 ref.

The adsorption of poliovirus from primary and secondary effluents was examined using packed soil columns 250 cm in length and batch tests with loamy sand. Virus-seeded primary and secondary effluents were applied for nine consecutive days to soil columns; fluid samples were collected at various depths along the columns. Batch tests were conducted in a centrifuge with varying soil concentrations and constant virus concentrations. Poliovirus adsorption on the soil columns was similar for both primary and secondary effluent. In 1-ml samples, viruses were not detectable below 40 cm in primary or secondary effluent flooded columns; in one case, viruses reached a depth of 80 cm in secondary effluent tests. Passage of the effluents through the top 5 cm of the columns removed about 1 log of virus, but the removal of another log of virus required passage through an additional 35 cm of soil. The viable virus concentration after one day of storage decreased by about 50% in primary effluent and by 47% in secondary wastes. About 5 plaque-forming units/ml were desorbed from the soil column to a depth of 80 cm by flooding with deionized water immediately after primary effluent application. The adsorption of poliovirus was not influenced by the organic concentration at the various depths but was directly dependent upon the soil type; low adsorption occurred with unconsolidated silty sand and gravel.

MISCELLANEOUS

J001
AN ANALYSIS OF CONSTRUCTION COST EXPERIENCE FOR WASTEWATER TREATMENT PLANTS,

Otakie, G. F.

Municipal Construction Division,
United States Environmental Protection Agency,
Washington, District of Columbia.

1976. 44 p, 6 fig, 13 tab, 3 append. Technical Report EPA-430/9-76-002.

Waste water treatment plant construction bid data were gathered in an effort to develop construction curves for estimating treatment plant costs. A data base was established with information from federally-funded construction projects. Input to the data base for each project included: grant-eligible construction costs; cost projections; design treatment level (new plant, upgraded plant, or upgraded/expanded plant); and individual treatment processes added or expanded (activated sludge, filtration, nitrification, secondary, tertiary). Distributions of treatment plants in the data base by design flow rate, principal unit processes, treatment level, and construction are listed. Linear regression analysis was used to derive cost curves for secondary plants, both new and upgraded from primary plants. Costs for actual construction programs were compared with predicted costs from an EPA guide for construction cost estimation.

J002
WATER RESOURCES - THE PRODUCTIVE CONTRIBUTION OF POLLUTION CONTROL,

Rowntree, N.

Chemistry and Industry, No. 15, p 631-633, August, 1977.

Activities and objectives of the Water Resources Board of England and Wales are described in an award address by Sir Norman Rowntree for the Society of Chemistry and Industry. The Trent research program, conducted by the Trent River Board in conjunction with the Water Resources Board, was initiated to facilitate compliance with higher effluent standards and the development of water resources. Technical aspects of water pollution and water quality control are discussed, including monitoring and characterization of effluents, the effects of pollution, and waste water treatment processes. The need for long term planning in water management is discussed. A reevaluation of water quality standards for particular application is suggested.

J003
TIME SERIES ANALYSIS ON AMMONIA CONCENTRATION AND LOAD VALUES OF THE RIVER RHINE,

Mueskens, P. J. W. M., and Hensgens, W. G. J.

Nijmegen Catholic University, The Netherlands,
Department of Analytical Chemistry.

Water Research, Vol. 11, No. 6, p 509-515, 1977. 2 fig, 4 tab, 8 ref.

The autocorrelation technique was used to statistically evaluate a series of data on ammonia concentrations and load values collected for the Rhine River over a 5-yr period. The purpose of the investigation was to separate observation noise from process fluctuations and to prove the presence of a periodicity or trend in the process. A derivation of the autocorrelation function is presented. Standard deviations and means were calculated for ammonia concentrations and load over 4 biannual periods and the total period of 5 yrs. An autocorrelation program was used to calculate autocorrelograms. Analysis of variance indicated that three factors could cause variance in sample values: analytical errors, sampling errors, and fluctuations in ammonia concentrations. Examination of ammonia concentrations in the time series revealed that ammonia load was a stochastic variable with an annual periodicity and a slightly decreasing trend. For ammonia concentrations distinct trends were observed within but not between the biannual periods.

J004
ALABAMA,

Water and Sewage Works, Vol. 124, No. 9, p 20, September, 1977.

Approximately $150 million has been appropriated by the state of Alabama and the federal government for municipal waste water treatment programs throughout the state. Individual cities receiving funds for improvements on waste water disposal systems will provide 75% of the necessary monies. Federal funds will be used to upgrade the primary level treatment plant at Bay Minette to secondary status. A pollution abatement program directed by the Jefferson County Commission will be used to clean up Patton Creek, with additions to the Valley Creek plant and construction of an interceptor system for the upper portion of the area serviced by the facility. The secondary treatment plant at Decatur will be replaced and a new plant will be constructed at Huntsville. Additional projects designated for partial federal funding are described.

J005
WHITHER POLLUTION CONTROL?,

Lester, W. F.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 327-331, 1977. 1 fig, 2 tab, 3 ref.

Various aspects of water pollution and water quality management in the United Kingdom are discussed. The organization of pollution control by the 10 regional water authorities in England and Wales is described. Standards imposed by the Control of Pollution Act of 1974, the main body of water pollution control legislation in England, are discussed. The Act grants new powers to the state for discharges of effluent to rivers, estuaries, and the ocean. Water quality standards for potable water supply purposes, industrial use, and spray irrigation of effluents are discussed. The national expenditure for water-related services is discussed. Results of water quality and river pollution surveys in England are presented. Philosophies and objectives of the Royal Commission and the European Economic Community are discussed.

J006
WASTEWATER LOANS READIED BY EPA,

The American City and County, Vol. 92, No. 9, p 28, September, 1977.

The U.S. Environmental Protection Agency's interim regulations on loan guarantees for waste water treatment works construction are discussed. The purpose of EPA loan guarantees is to provide a source of funding for municipalities that can not sell bonds or other maturities at reasonable rates on the open market. Financing can be used to cover all or part of a project. Applicants must prove that credit at reasonable rates from other sources was unavailable by furnishing the results of public bidding, certification from a municipal bond underwriter, certification from two or more local banks, and certification from the Farmers Home Administration. Proof of ability to repay the loan must also be furnished. The application fee is $1000 or one-eighth of 1% of the loan amount, whichever is greater but not to exceed $25,000. Repayment must be made within a period set by the EPA.

J007
POLLUTION CONTROL AND LEGISLATION IN THE FEDERAL REPUBLIC OF GERMANY,

Leroff, H. E.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 271-276, 1977.

Water pollution control problems in West Germany are compounded by the fact that pollution is imported by waterways that originate outside Germany's boundaries. International cooperation on water pollution control is enforced by the 1972 Treaties of Oslo and Paris, the European Water Resources Protection Commission, and the Rhine Protection Commission. The framework for water pollution control legislation in West Germany is the Water Resources Act of 1957 with its fourth amendment adopted in 1976. According to the 1957 Act, the creation of detailed regulations and the enforcement of water policy are left up to the individual states. Waste disposal is governed by the Federal Waste Disposal Law of 1972. The law's definition of waste excludes waste water discharged into the courses of waste water treatment plants, but sewage sludge treatment and disposal must conform to waste disposal regulations. Political interference and shortcomings of the legislation have allowed industries and municipalities to resist providing waste water treatment. A waste water taxation program is being considered under which the states will pay a waste water tax for discharging waste water into waterways, with the amount of tax depending on the contamination level of the waste water. Policies of the United Kingdom, the United States, and the German Federal Republic on uniform water quality standards are compared.

J008

POLLUTION CONTROL AND LEGISLATION--THE DUTCH APPROACH,

Scheltinga, H. M. H.

Journal of the Institute of Water Pollution Control, Vol. 76, No. 3, p 263-270, 1977. 1 fig, 2 ref, 2 append.

Various aspects of water pollution control and legislation in the Netherlands are discussed. The Pollution of Surface Waters Act of 1970 is the central core of water quality protection in the Netherlands. Based on the principle of decentralization, the Act delegates a portion of the responsibility for water quality management to provincial authorities. A 5-yr plan (1975-1979) was implemented to insure coordination and uniformity of practice with respect to planning, permits, and enforcement. A discussion of general water standards and objectives is presented. Discharge standards include required full biological sewage treatment for systems serving more than 500 people and "best practicable technology" treatment for industries. Taxation for waste treatment is levied on a per capita basis for municipal wastes and in terms of COD and N loading for industrial wastes. Additional taxation for dischargers of heavy metals is being considered. The results obtained in water pollution control since 1970 are illustrated in a projection of 1960-1980 total pollution loading and biological treatment plant capacity in the Netherlands, with 60% of the total biodegradable organic pollution loading (municipal and industrial) slated for full biological treatment by 1980.

J009
EPA INDEXES SHOW SHRINKING COST HIKES,

Engineering News-Record, Vol. 199, No. 12, p 129, September, 1977. 3 tab.

The U. S. Environmental Protection Agency's city indexes for waste water treatment costs are described. Cost indexes are presented for 25 cities in each of three categories based on hypothetical treatment facilities. The hypothetical facilities include a 5-mgd municipal waste water treatment plant, a 50-mgd municipal waste water treatment plant, and a complete urban sewer system. The cost index for the second quarter of 1977, based on the third quarter of 1973, and the percentage of change from the second quarter of 1976 are given for each of the cities. The cost index is also broken down according to percentages for labor, civil materials, other equipment, construction overhead, and buildings. Cost figures indicated that although sewage treatment costs rose from 0.7% to 8.3% above first quarter levels, the rise in construction costs was lower for the second quarter. Average cost increases from the first quarter to the second quarter were 1.9% for the 5-mgd plant, 2.0% for the 50-mgd plant, and 1.9% for the complete urban sewer system.

J010
WASTEWATER TREATMENT PONDS,

1974. 14 p, 14 ref. Technical Report EPA-430/9-74-011.

Technical information on waste water treatment ponds is provided to supplement federal guidelines on the design, operation, and maintenance of municipal waste water treatment facilities. Photosynthetic ponds, aerated ponds, and complete retention ponds are the types of waste water ponds emphasized in this publication. Background information on the ability of flow-through photosynthetic ponds to meet secondary treatment requirements is presented. Various aspects of controlled discharge ponds which are designed to retain waste water on a long-term basis are discussed, including design criteria for ponds in operation and the selection of the optimum day and hour for the release of effluents. Criteria for the operation of complete-mix and partial-mix aerated ponds are given. General requirements are listed for positive disinfection, prevention of short circuiting, and protection of groundwater from pond seepage. Supplemental treatment methods for flow-through photosynthetic ponds are described, including conversion to controlled discharge, intermittent sand filtration, land treatment of pond effluents, addition of supplemental aeration, and chemical coagulation.

J011

DESIGN CRITERIA FOR MECHANICAL, ELECTRIC, AND FLUID SYSTEM AND COMPONENT RELIABILITY,

1974. 54 p. Technical Report EPA-430-99-74-001.

Design criteria and minimum standards of reliability for mechanical, electric, and fluid systems and components of waste water treatment equipment are discussed. Works design criteria are examined for works location, works expansion and/or upgrading, piping requirements, pipes subject to clogging, provisions for draining pipes, maintenance and repair of feed lines, component maintenance and repair requirements, and isolation of hazardous equipment. Waste water treatment system requirements are given for trash removal or comminution, grit removal, settled solids removal, controlled diversion, and unit operation bypassing. Component backup requirements are described for bar screens, pumps, comminution facilities, primary sedimentation basins, sedimentation basins, activated sludge units, aeration basins, air diffusers, flash mixers, flocculation basins, and disinfectant contact basins. Provisions for isolating components for repair and maintenance, as well as for protection of components from overload, freezing, and up-lift due to groundwater, are indicated. Design criteria are also given for electric power systems, instrumentation and control systems, and auxiliary systems. Minimum standards are established according to three classes of waste water treatment works: works which discharge into navigable waters which could be irretrievably damaged after a few hours by low-quality effluent; works which discharge into navigable waters which could be damaged by continued receipt of low-quality effluent; and the remaining facilities.

J012

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE DELAWARE COUNTY, OHIO BOARD OF COMMISSIONERS, OLENTANGY ENVIRONMENTAL CONTROL CENTER AND INTERCEPTOR SYSTEM,

1976. 501 p, 36 fig, 20 tab, 9 append. Technical Report EPA-5-OH-Delaware-XX-WWTP.

The final environmental impact statement for the proposed Olentangy Environmental Control Center and Interceptor System in Delaware County, Ohio, is presented. The project includes a 1.5-mgd sewage treatment facility with a peak capacity of 3.4 mgd. The treatment process includes a two-stage activated sludge facility, phosphate removal, tertiary rapid sand filtration, chlorination, post-aeration, disinfection with ozone, anaerobic digestion of sludge, and disposal of treated sludge to a state-approved sanitary landfill site. The proposed cost for the control center and interceptors was $11.05 million. A description of the environment without the proposed project is presented, including topography, geology, soils, groundwater, surface water, biology, air quality, land use, historic and archaeological sites, environmentally sensitive areas, population projections, economic forecasts, and aesthetics. Alternatives to various aspects of the proposed project are described, including flow reduction measures, interceptor alternatives, site location, treatment process approaches, discharge point selection, and methods of sludge disposal.

The effects of the Olentangy project are evaluated with respect to water quality and quantity, air, land use, biology, and the general environment.

J013

RECLAIMED WATER FOR CAPE PENINSULA,

The Civil Engineer in South Africa, Vol. 19, No. 7, p 163-164, July, 1977.

Limited water resources in the Cape Peninsula region of South Africa have led to an investigation of the reclamation and reuse of treated sewage effluents by the Water Research Commission, the city of Cape Town, and the National Institute for Water Research of the CSIR. Extensive studies have been conducted on the use and hydraulic suitability of the sand beds of the Cape Flats for the storage, infiltration, and abstraction of natural water or purified effluents. Hydrogeologic studies indicated that approximately 75,000 cu m of water, or 3 cu m H2O/day/m of coastline, was being lost daily to False Bay by subterraneous flow. The interception of this water through 50 boreholes to be drilled along the coast has been recommended. Current research has focused on the possible effects of pollutants on this water supply and on operations of a 300-cu-m/day pilot plant at the Athlone Sewage Works.

J014

SURVEY FORECASTS FLOOD IN 1978 SEWERAGE MARKET,

Engineering News-Record, Vol. 199, No. 14, p 40-41, October, 1977. 1 tab.

A survey of 66 major sanitary districts in the United States indicated that they intended to spend approximately $2 billion for sewer and waste water treatment projects in 1978, with half of the funds slated for new, upgraded, or expanded treatment plants. Much of the support of these projects will be provided by the EPA's sewerage construction grants program. Estimates by the 66 districts of expenditures during fiscal 1979 totalled $1.1 billion, 40% less than the anticipated 1978 expenditures. The districts also reported an increase in the number of bidders per project in fiscal 1977 and the receipt of contract bids which averaged 12% below the engineer's projected cost.

J015

ADVANCED SEWAGE TREATMENT PLANTS, AN EPA PLANNING FLOP,

Engineering News-Record, Vol. 199, No. 19, p 12-13, November, 1977.

A study by the General Accounting Office (GAO) that challenged the EPA's funding of advanced municipal waste water treatment plants and the corresponding reply by the EPA are discussed. A study by Vertex Corporation of McLean, Virginia, for EPA called for a temporary moratorium on federal funding for advanced plants, thereby agreeing with the GAO's recommendations. Current estimates suggest that approximately $21 billion in federal funds will be required to construct tertiary treatment plants for the estimated 1990 United States population. Fundamental defects in advanced waste water treatment policy cited by Vertex included the lack of planning based on technical information rather than on water quality standards, mathematical models, and wasteload allocations; and the apparent funding inequities among the states. The Vertex report also recommended the acquisition of more information on hydrodynamics, waste water discharges, water quality, sediments, and aquatic biology, along with an extensive cost-benefit analysis of advanced wastewater treatment. Review of areas of the 1972 Federal Water Pollution Control Act amendments which concern advanced waste water treatment is suggested.

J016

RISING SEWAGE PLANT OPERATION COSTS BEG ENGINEERED SOLUTIONS,

Engineering News-Record, Vol. 199, No. 14, p 71, October, 1977.

Through analyses of current trends in sewage treatment costs, the EPA has predicted annual sewage treatment expenditures in the United States of $148.4 billion by 1990. The Water Pollution Control Federation's estimates are even higher at $150 million for operating costs and $450 billion for construction of municipal and industrial facilities. Current high costs for operation and maintenance as well as for energy, chemicals, and labor have indicated the need for engineered improvements in sewage plant operating efficiency with particular emphasis on reducing costs. A survey revealed that in 38 sewage treatment plants annual operating and maintenance costs exceed amortized capital costs at 21 of the plants, and that in 18 secondary plants cumulative operation and maintenance costs exceeded their design and construction costs in less than 4 yrs. For primary plants, costs for operation and maintenance exceeded costs for initial design and construction after an average of 13.4 yrs, and for all the plants in the survey after an average of 6.1 yrs.

J017

WATER QUALITY MANAGEMENT--PROBLEM AREAS IN SEWERAGE AND SEWAGE DISPOSAL,

Lewin, V. H.

The Public Health Engineer, Vol. 5, No. 4, p 125-127, September, 1977.

Various topics are discussed in response to the newly organized tri-purpose regional water and waste treatment authorities in England. The need for more effective communications systems, telemetry, data acquisition, and information storage and retrieval systems is discussed. Specialized training and education programs are cited as important in assuring adequate water and waste water treatment by regional authorities. Sewer rehabilitation programs are suggested to relieve overloading of treatment plants produced by infiltration and inflow in deteriorated sewage systems. Adjustments in unit processes according to pollutant load are suggested. Various areas of water quality planning and waste water management are discussed, including the development of long-term plans which are periodically reevaluated. The need for better maintenance and a greater understanding of the workings of mechanical and electrical equipment is described.

J018

CONCRETE FORMING FOR WATER AND WASTE TREATMENT PLANTS,

Concrete Construction, Vol. 22, No. 11, p 615-617, November, 1977.

Concrete has been used as a construction material for a wide variety of water, sewage, and industrial waste treatment projects. Construction requirements may vary greatly from one project to the next, but site-cast concrete can be designed and built to provide desired hydraulic characteristics, to produce a watertight system, and to accomodate almost any other design requirement. Reusable factory-built modular forms are discussed as an alternative to custom-built forms which can rarely be reused. Modular forms which are currently manufactured are usually in the form of panels on a steel-frame backing faced with plastic-coated plywood to insure smooth surfaces after multiple reuse. The panels can be connected to produce straight or curved walls, Y-walls, haunches, and slabs. Experiences with the use of modular forms during construction at the Meander Water Pollution Control Project in Mineral Ridge, Ohio, are described.

J019

WELSH WATER RE-ORGANIZATION,

Water Services, Vol. 81, No. 978, p 453, August, 1977. 1 fig.

The Welsh National Water Development Authority has reorganized its 25 single-purpose water supply, river, and sewage divisions into seven regional authorities which will cover all three purposes. Slated to go into effect on or about April 1, 1978, the new multipurpose divisions will be the Gwynedd, West Wales, Gower, Dee and Clwyd, Wye, Usk, and Taff divisions. The initial capital expenditure for the reorganization will be approximately 500,000 pounds and annual operating costs after the initial 3-yr period should be similar. Approximately 100 jobs, or 2% of the 5500 existing positions, will be gradually eliminated in the reorganization process. Services will be coordinated from a single headquarters location within each regional division.

J020

VALVES FOR THE WATER INDUSTRY,

Water Services, Vol. 81, No. 978, p 476-481, August, 1977.

Recent developments in valve design and construction for industrial, municipal, and water-related operations are described. The use of ductile iron in valves because of its resistance to mechanical and thermal shock and to corrosion is described. Ease of pouring, the ability to cast light sections of very high strength, and the high quality surface finish are cited as advantages of using ductile iron castings for valve components, gear box casings, combustion engine parts, and other products. The use of elastomers instead of natural rubber for valve components alleviates problems associated with absorption, swelling, aging, and attack by ozone, hydrocarbons, and acids. Applications of elastomers for butterfly valves and resilient sealing gate valves are discussed. Research into the use of stainless steel for valve components, to allow more compact designs and to resist corrosion by ionized waters, is discussed.

J021

EPA ENLISTS ARMY TO MANAGE SEWAGE PLANT CONSTRUCTION,

Engineering News-Record, Vol, 199, No. 13, p 10, September, 1977.

The EPA has enlisted the aid of the U. S. Army Corps of Engineers in the supervision of design and construction of federally-funded municipal waste water treatment plants. The Corps will insure smooth construction for large projects, review design specifications and bid documents, identify construction problems and solutions, and cooperate with the community's private consulting engineer. The tentative agreement between the Corps of Engineers and the EPA was announced after the release of a report by the General Accounting Office that cited problems in design and construction stages in the EPA's multibillion dollar construction program. The Corps will provide 600 man-yrs at a cost of $20 million during the first year of the program, which is still subject to approval by the Office of Management and Budget.

J022

ORSANCO: AN INTERSTAGE AGENCY,

Boes, R., and Weaver, L.

Ohio River Valley Water Sanitation Commission,
Cincinnati, Ohio.

AIChE Symposium Series, Vol. 73, No. 167, p 262-266, 1977. 1 ref.

ORSANCO (Ohio River Valley Water Sanitation Commission) has been administering a regional program to control water pollution in the 155,000-sq mile Ohio

River basin which includes Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia. The commission's purpcses are to coordinate the acquisition of information on stream quality characteristics, to evaluate pollution abatement, and to guide additional control efforts while insuring adequate water quality within the basin for purposes. The committee also adopts and enforces effluent limitations and standards. Biological monitoring and sampling programs have been used to assess water quality and the status of municipal and industrial control facilities. The commission was also responsible for an order to expand five waste water treatment plants in the Pittsburgh and Cincinnati metropolitan areas in 1964. Along the Ohio River, treatment facilities provide service for 99% of the 3 million sewered population and 90% of the 1700 industrial dischargers. Comparisons of water quality for 1952-53 and 1963-64 indicated lower levels of mineral constituents associated with mine drainage and waste water dischargers, higher dissolved oxygen levels, lower coliform levels, and other water quality improvements as a result of the program. Future interest of the commission will be focused on the effects and bioaccumulation of pollutants by aquatic life and on other water quality management programs.

J023

INTERNATIONAL COOPERATION IN STUDYING THE HEALTH ASPECTS OF ORGANIC CONTAMINANTS IN INDIRECTLY REUSED WASTE WATER,

Zoeteman, B. C. J.

National Institute for Water Supply and International
Reference Center for Community Water Supply,
World Health Organization,
Leidschendam (The Hague), The Netherlands.

Annals of the New York Academy of Sciences, Vol. 298, p 561-573, 1977. 2 fig, 6 tab, 24 ref.

Since much of the world's water supplies contains some proportion of sewage effluent which enters drinking water through indirect reuse, more extensive investigations into the health effects relating to direct and indirect reuse of waste water for human consumption have been recommended. Health risks associated with organic contaminants in tap water may be assessed by identification of the individual chemicals and by examination of the toxicologic properties of individual and combined chemicals, or by evaluating the characteristics and effects of the water as a whole. The principal organic contaminants found in drinking water in the United States are described. European studies on health aspects of organic contaminants in drinking water have included a survey of organic contaminants in tap water of 20 major cities in the Netherlands; preparation and toxicologic screening of concentrates of organics in drinking water; and epidemiologic studies. Studies concerned with source identification of drinking water contamination and with regulatory programs on environmental chemicals in Europe are described.

J024

MARINE POLLUTION: A MULTIFACETED, MULTI-AGENCY DETECTION, RESEARCH AND ENFORCEMENT PROGRAM,

Sea Technology, Vol. 18, No. 10, p 10-17, 49-50, October, 1977.

Activities of the numerous federal and civil organizations involved in marine pollution programs, and federal measures being taken to control or eliminate pollution of the marine environment, are described. Among the agencies involved in detection, clean-up, and research of ocean pollution are the National Oceanic and Atmospheric Administration (NOAA) and the U. S. Coast Guard. Programs being conducted by the various agencies to control ocean dumping of sewage sludge and other wastes are described. The Marine Ecosystems Analysis (MESA) project under the auspices of NOAA has investigated waste dumping and its environmental effects in the New York Bight and Puget Sound, Washington. A 7-yr study on the New York Bight was initiated to determine the fate and effect of pollutants on the ecosystem, to quantify environmental factors involved in designing and siting offshore structures, and to provide other information on coastal processes. Various projects on oil pollution and the disposal of oily wastes are described. Studies being conducted by the U. S. Navy on treatment and disposal of sanitary sewage for ships are described.

J025

HISTORIC TURNING POINTS IN MUNICIPAL WATER SUPPLY AND WASTEWATER DISPOSAL, 1850-1932,

Tarr, J. A., and McMichael, F. C.

Carnegie-Mellon University,
Pittsburgh, Pennsylvania,
Department of History, Technology, and Urban Affairs.

Civil Engineering-ASCE, Vol. 47, No. 10, p 82-86, October, 1977.

During much of the 19th century, government involvement in waste water management was minimal, and the cesspool-privy system was the only means for collection and treatment of human wastes. Urban population growth and the development of new urban water supply systems from 1850 to 1890 overloaded existing waste treatment systems. Piped water supply systems and the resulting increase in the per capita water consumption also placed great demands on the cesspool-privy system. Water-carriage removal and sewerage systems were adopted to alleviate overflowing of cesspools and privies. From 1880 to 1890 the virtues of separate vs. combined sewer systems were debated. An extensive report by Rudolf Hering, an American sanitary engineer, on the status of sewer systems in Europe was published. During the period 1900-1932, stream pollution by sewage and resulting higher typhoid fever rates in downstream communities led to more attention to water pollution control and water treatment. Sand filters and trickling filters were first evaluated for water and waste water treatment during the early part of the 20th century.

J026

MAINE WASTEWATER TREATMENT PLANT OPTS FOR SOLAR HEATING,

Water and Sewage Works, Vol. 124, No. 11, p 72, November, 1977.

The design for the roof and parts of the walls of the waste water treatment plant in Ellsworth, Maine, includes passive solar collector panels constructed of aluminum and translucent fiberglass. The ten sliding roof panels allow solar heat and light to enter the building and also provide natural ventilation during the summer months. Land costs, the effect of the location on construction and operating costs, topography, soils, environmental impact, influence on property values, and multiple site utilization were all considered before the plant's location was finalized. A town-owned, waterfront parcel in a residential area was selected for the plant. Because of the plant's compact design, a recreational area will also be situated at the site. Heating costs are being minimized by the use of a system which differentially supplies heat to areas occupied only by mechanical equipment and those occupied by plant personnel. The solar collector panels were manufactured by the Kalwall Corporation of Manchester, New Hampshire.

J027

BALANCE IN TRAINING FOR LATIN AMERICAN WATER AND WASTEWATER UTILITIES,

Carefoot, N. F.

Pan American Health Organization -- World Health Organization,
Lima, Peru.

Journal of the American Water Works Association, Vol. 69, No. 12, p 641-643, December, 1977. 2 tab.

Training programs for supporting subprofessional, technical, and trade personnel in water and waste water treatment have fallen behind needs for trained personnel in Latin America. A manpower and training resources inventory was recently completed in Peru. An estimated 80% of current workers require training for their present jobs. An estimated 6,000 additional employees will be required by water and waste water utilities within 5 yrs. A 30% increase in the portion of city dwellers served by sewers has been adopted as a minimum goal by 28 countries in the western hemisphere. Various aspects recommended for a balanced training program include: a preparatory working group, inventories of human and training resources, review of personnel policies, establishment of training policies, preparation of training material and methodology, cooperation between training institutions, and an accountability system.

J028

EVALUATING WASTEWATER FACILITY STAFFING NEEDS,

Culp, G., Benjes, H. H., Jr., and Puntenney, J.

Culp, Wesner, Culp,
El Dorado Hills, California.

Journal Water Pollution Control Federation, Vol. 49, No. 11, p 2226-2237, November, 1977. 15 tab, 2 ref.

Plans to expand the Metropolitan Denver Sewage Disposal District (MDSDD) secondary treatment facilities from a 98-mgd to a 170-mgd capacity led to a study on staffing needs. The program included a comparison with available staffing guidelines, comparisons with other plants, on-site interviews of existing MDSDD personnel, and recommendations of appropriate staffing levels. The various findings of this survey are reported. By reviewing work tasks, the minimum staff requirement was estimated as 177. The preliminary MDSDD plan had provided for 199 positions, a level of staffing considered consistent with similar plants. Environmental Protection Agency staffing guidelines agreed with MDSDD's preliminary staffing plans for their expanded facility. It was determined that the 22 positions could be left unfilled until a definite need was demonstrated. The results of this survey indicated the need for a thorough study of a specific plant's needs for an accurate estimation of staff requirements.

J029

ENVIRONMENTAL PROBLEMS OF INDIA AND THEIR POSSIBLE TRENDS IN FUTURE,

Parikh, J. K.

International Institute for Applied Systems Analysis,
Schloss Laxenburg,
Laxenburg, Austria.

Environmental Conservation, Vol. 4, No. 3, p 189-198, Autumn 1977. 1 fig, 5 tab, 13 ref.

Environmental problems in India and their possible influence on the future are reviewed. The anticipated population growth, increased industrial and agricultural activities, and depletion of natural resources are expected to present serious problems over the next 25 years. The quality of the air, water, sanitation, health, and housing are considered. A quantitative outline is presented for various conservation techniques for forests, soils, and wildlife. Two of the most serious problems in India are water pollution and deforestation. Presently, in rural areas, less than 10% of the population is served by existing water distribution and waste water treatment systems. Unless drastic measures are taken, this percentage may not exceed 30% by the year 2000. The lack of adequate sewerage and sanitation facilities could lead to severe degradation of existing water supplies. Further consideration of the effects of agricultural runoff containing wastes, pesticides, and fertilizers on rural water sources is also suggested.

J030

SEWER USE CHARGE SURVEY REVEALS WIDELY DIVERGENT POLICIES,

Dukes, L. S., and Moore, R. R.

Charlotte/Meklenburg Utility Department,
Charlotte, North Carolina.

Public Works, Vol. 108, No. 12, p 48-49, 83, December, 1977. 2 fig, 2 tab.

A survey was taken to compare the current and proposed sewer use charge rates employed by the Charlotte-Mecklenburg Utility Department in Charlotte, North Carolina, with those of other cities with similar facilities. Information was obtained from 74 publicly-owned systems. The largest was Los Angeles with a 455-mgd capacity; the smallest was New London, Connecticut, having a 6-mgd system. The survey solicited information on financing for operation, maintenance, and repair. Funding for capital expansion of collection and treatment systems was assessed. Charges based on waste water volume were significantly different for the various utilities. For a monthly volume of 1,000 cu ft, charges ranged $0.98-8.68 for users inside city limits and $3.02-13.00 for users outside city limits. Corresponding charges for a monthly volume of 100,000 cu ft were $71.65-531.50 and $103.25-1478.20, respectively.

J031

SEWERAGE COSTS RISING AT A FASTER PACE,

Engineering News-Record, Vol. 199, No. 25, p 102, December, 1977. 3 tab.

Construction costs for waste water collection and treatment facilities in the United States are reported by the Environmental Protection Agency to have taken a sharp rise in the third quarter of 1977. This rise in cost parallels a similar increase in the concrete pipe and lumber industries. For 25 cities across the United States having waste water treatment plants of the 5-mgd treatment size, cost indexes averaged 126.3 in the July-September period, up 2.5% from the previous quarter. For 50-mgd treatment plants, cost indexes averaged 138.5, a 3.2% increase over second-quarter figures. Cost indexes for complete urban sewer systems averaged 143.2 in the third quarter, up 3.4% from the April-June period.

J032
COMMUNITY ACTION ON WATER POLLUTION,

Friedman, J. J.

Cook College,
Rutgers, New Jersey,
Department of Human Ecology.

Human Ecology, Vol. 5, No. 4, p 329-353, 1977. 2 tab, 48 ref.

A community's progress toward the institution of water quality control is relative to the influence of polluting industries on the community, the cost-benefit factors, and the characteristics and needs of the community. Options available to communities for pollution control include EPA grants for the construction of new treatment facilities, HUD's Water and Sewer Facilities Program providing matching grants for sewers and waste disposal facilities, and the adoption and enforcement of regulations restricting pollution through industrial wastes. The benefit of these alternatives is considered collective, or shared by the entire community. Costs, however, may be more specific, falling mainly upon the users of treatment facilities and polluters, such as local industry. Opposition by local industry can influence the action taken by a community toward pollution control. Other factors that influence a community's application for waste control grants include location, need, population potential, and resources.

J033
DAMAGE TO POLLUTED LAKES CAN BE REVERSED, STUDY SAYS,

Water and Wastes Engineering, Vol. 14, No. 12, p 35, December, 1977.

A study by a group of Cornell University researchers has concluded that dissolved phosphorus presents the major threat to freshwater lakes and that the pollution can be reversed. Erosion, which contributes undissolved phosphorus to water, is not as serious a threat to the water quality as dissolved phosphorus, which controls the growth of algae. This conclusion contradicts federal guidelines. Sewage is cited as the primary source of dissolved phosphates, originating from the use of phosphate detergents. Prohibiting use of these detergents and instituting tertiary treatment of wastes provide the most economical control. Water quality regulations should meet the needs of individual watersheds and their biological characteristics. Removal of phosphorus input from agricultural drainage and unsewered areas was found to be more costly than the other controls and treatment. Public awareness and concern is also considered.

J034

PHOSPHATE PROBLEMS COME TO THE UNITED KINGDOM,

Roberts, F. W.

Effluent and Water Treatment Journal, Vol. 17, No. 11, p 599-600, November, 1977.

Nitrogen and phosphorus in effluents will stimulate plant growth, causing eutrophication of receiving waters. There is also a possibility of adverse health effects due to nitrates. Since plant growth requires a number of nutrients, limiting the supply of one element will limit algal proliferation. Limiting phosphate is considered the most economical option because most phosphate can be traced to sewage effluent, while much of the nitrate is contributed by drainage from agricultural land. The Anglian Water Authority reported severe algal growth, attributed to high phosphate levels, in one of their reservoirs. Nitrilo-triacetic acid (NTA) could be used as a substitute for tri-poliphosphate in detergents. Because of health objections to NTA, chemical coagulation will probably be used to remove phosphates from sewage. The coagulants can be added during primary sedimentation, during biological treatment, or during tertiary treatment. Ferrous sulfate added during biologicaltreatment will be oxidized to ferric sulfate, which has superior properties in phosphate removal.

J035

CALIFORNIA TAKES HALTING LEAD ON SEWAGE PLANT CM,

Engineering News-Record, Vol. 200, No. 3, p 53, January, 1978.

California now requires applicants for federal waste water treatment construction grants to submit plans for construction management of projects costing over $5 million. Separate construction managers are not required. This approach allows for project variability and flexibility. The Environmental Protection Agency (EPA) has delegated more responsibility for water pollution control to California than to any other state. California and the EPA believe that a reduction in change orders and delays will more than offset any additional costs incurred by retaining a construction manager. The EPA is sending other states information about the program and encouraging them to adopt similar requirements. The EPA may order construction management at a later date.

J036

REGIONAL WATER QUALITY PLANNING: A VIEW FROM SOUTHEAST MICHIGAN,

Akeley, R. P., Jr., Collins, P. G., Harlow, C. D., and Ridgway, J. W.

AIChE Symposium Series, Vol. 73, No. 167, p 288-296, 1977. 4 fig, 1 tab.

The Southeast Michigan Council of Governments (SEMCOG) received $5.1 million to produce a plan for water quality management for the Detroit metropolitan region. Data requirements were extensive. Water quality models include: STORM-LLODS, a precipitation-runoff screening model; QUAL II, a stream quality routing model; and RUNQUAL, which routes surface runoff plus base flows through a converging, branching network of pipes or channels. Southeast Michigan has a complicated mixture of point, nonpoint, and intermittent point sources of pollution. Facilities planning was to include careful technical reviews, improved cooperation with the local units, close communication with the state clearinghouse, integration of facilities reviews and development of the water quality management plant, cooperation during facilities plan development, and a sewer service area map. Population forecasts were necessary for anticipating appropriate service area boundaries. The Council was given 2 years in which to create a plan that was both technically sound and implementable.

J037

TECHNOLOGICAL ECONOMICS APPLIED TO WASTE RECOVERY AND TREATMENT PROCESSES,

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Birmingham, England,
Department of Chemical Engineering.

Effluent and Water Treatment Journal, Vol. 17, No. 9, p 467-473, September, 1977. 5 tab, 6 ref.

Model for estimating costs of waste recovery processes and operations are presented. Waste recovery equipment costs, particularly for the more basic items, can vary widely. Operating costs are conventionally estimated as a function of raw materials, labor, energy, and fixed investment related costs. The total energy cost rarely exceeds 20% of the total product cost. The chemical reagents required to treat the effluent may be an appreciable part of the total cost. A more complete and accurate operating cost figure can probably be obtained by examining the particular situation rather than by relying on published information. Depreciation rarely represents a real cash flow, but rather an arbitrary allocation of change in value. The most important single factor affecting the viability of a waste recovery scheme is the market for the recovered materials.

J038
EPA HALTS AWARD,

Engineering News-Record, Vol. 199, No. 25, p 46, December, 1977.

The Environmental Protection Agency (EPA) postponed funding of an $80 million waste water treatment plant. The action was in response to bid specifications requiring performance bonds covering equipment from potential suppliers which were considered too restrictive. Officials of the Passaic Valley Sewerage Commission felt that the ruling would unnecessarily delay construction of a $500-million treatment plant in Newark, New Jersey. It might also prevent New Jersey from meeting a federal deadline of December 31, 1989, to end ocean dumping of sludge. The specifications required suppliers of the thermal sludge conditioner to have at least 5 years of experience with the equipment or to post a bond to guarantee the system's performance for 5 years. According to the commission, an inexperienced supplier might install a system having defects which would not be found during construction or initial testing. Only two United States firms currently manufacture the wet air oxidation system: Zimpro Inc., of Rothschild, Wisconsin; and Envirotech Corp., in Menlo Park, California. The EPA had initially approved the experience requirement, but decided later that it only inhibited free competition. The Passaic Valley Sewerage Commission has contemplated appealing the EPA ruling.

J039
THE IMPACT OF WATER SAVING WATER CLOSETS ON BUILDING DRAINS AND SEWERS,

Sharpe, W. E., and Cole, C. A.

Pennsylvania State University,
University Park,
The Institute for Research on Land and Water Resources.

Plumbing Engineer, Vol. 5, No. 6, p 20-21, 60, November-December, 1977. 4 tab, 6 ref.

The effect of the use of water-saving toilets on drainage and sewage systems has been evaluated. Water closets with discharges ranging 0.25-5.25 gallons per flush were compared in terms of solid sewage velocity, sewer pipe diameter, sewer pipe slope, and depth of flow. The average water-saving water closet discharges 3.5 gallons per flush. Necessary velocities for the transport of solid sewage were calculated as 1.5-2.0 ft/sec. The velocity for a water-saving toilet with a discharge of 3.50 gallons per flush was discovered to be 1.38 ft/sec. This velocity was considered adequate for sewage transport. The depth of flow was considered a potential problem in the use of water closets with a discharge of less than two gallons per flush. Large scale installation of low flow water closets in a Pennsylvania resort did not present adverse effects to the sewage system, although detailed data was not available.

J040

DISCHARGE OF NITROGEN, PHOSPHORUS AND ORGANIC MATTER INTO THE GULF OF BOTHNIA,

Ahl, T., Haverinen, A., Thorell, L., and Wartiovaara, J.

Limnological Survey,
Swedish Environment Protection Board,
Uppsala, Sweden.

Ambio, Vol. 6, No. 5, p 273-275, 1977. 4 fig, 1 tab, 12 ref.

Sources and quantities of nitrogen, phosphorus, and organic matter discharged into the Gulf of Bothnia, a feeder to the Baltic Sea, from Sweden and Finland were calculated. Major sources of nitrogen, phosphorus, and organic matter were determined to be rivers, municipal waste waters, and industrial waste waters. A total of more than 81,000 tons/yr of nitrogen in the form of ammonia, nitrite, nitrate, and organic matter was discharged into the gulf, 90% from rivers. The total quantity of inorganic nitrogen discharged was 22,000 tons and organic was 59,000 tons. A total of 6,200 tons/yr of phosphorus was released with under 5,000 tons from rivers, more than 600 tons from municipal waste waters, and more than 700 tons from industrial wastes. About 56% of the total phosphorus was organic, with the remainder being inorganic phosphate. An estimated 600,000 tons/year of 7-day BOD was discharged, with 54% contributed by industrial waste waters and 43% from rivers. The 7-day BOD loading on the Gulf of Bothnia was calculated at 5.16 g/sq m/yr. Bothnian Bay loading was estimated at 6.58 g/sq m/yr, and 4.51 g BOD/sq m/yr in the Bothnian Sea.

J041

EFFLUENT STANDARDS--EFFECT UPON DESIGN,

Garber, W. F.

Bureau of Sanitation,
Los Angeles, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 103, No. EE6, p 1115-1127, December, 1977. 1 fig, 4 tab, 8 ref.

Cost-benefit relationships and the practicality of water quality standards established by the California Water Resources Control Board are considered in terms of calculated environmental impact. A comparison of the degree of treatment required to meet these standards and the net environmental impact of contaminants and energy requirements showed an eventual negative net environmental impact. At some point, the impact of energy requirements for compliance with the water quality standards would exceed the benefits of the increased standards. Suggestions for preventing a negative environmental effect include: consideration of environmental cost-benefit relationships; establishment of the most effective point source controls and industrial waste pretreatment processes; and legislative enforcement of nonpoint source controls, such as domestic toxin discharges. It is further suggested that water quality criteria and environmental impact controls be adapted to the conditions existing in the receiving waters and to threshold toxicity levels for marine organisms. Consideration of water currents which can contribute to waste concentration and dispersion is recommended when establishing waste water standards.

J042

INPUT AND FATE OF PETROLEUM HYDROCARBONS ENTERING THE PROVIDENCE RIVER AND UPPER NARRAGANSETT BAY FROM WASTEWATER EFFLUENTS,

Van Vleet, E. S., and Quinn, J. G.

Rhode Island University,
Kingston,
Graduate School of Oceanography.

Environmental Science and Technlogy, Vol. 11, No. 12, p 1086-1092, November, 1977. 4 fig, 2 tab, 23 ref.

A sampling program was conducted to investigate the input of petroleum hydrocarbons to the Providence River and upper Narranganstt Bay by a municipal sewage treatment plant and to determine the transport mechanisms and fate of these hydrocarbons on entering the estuarine system. A one-year background survey had indicated that municipal waste water treatment plants may be significant contributors to oil pollution in estuarine and coastal waters. The discharged hydrocarbons were primarily associated with the suspended solids. Analysis of suspended material and sediments in the river and upper Narragansett Bay indicated that about half of the suspended hydrocarbons were rapidly settled out in the river; the remainder was transported out of the river and dispersed throughout the bay. The petroleum products were detected to a depth of about 40 cm in some sedimentary cores. The subsequent emergence of biogenic hydrocarbons revealed the extent to which oil pollution was present in these sediments. Effluent from the Fields Point Treatment Plant contained on the average 2.80 mg/liter of hydrocarbons, yielding a possible annual discharge of hydrocarbons into the Providence River of 226 metric tons.

J043

CANNING GROUP EXPANSIONS,

Water Services, Vol. 81, No. 980, p 598-599, October, 1977.

In October 1976 when Water Management Limited became part of the Canning Group, it became apparent that larger premises would be needed for construction of water treatment facilities and production of Water Management specialty chemicals for water conditioning. Larger manufacturing operations were established in Kidderminster, together with laboratories for their water treatment and conditioning consulting service. A complete analytical laboratory was made available, along with flocculents for water and sewage treatment and Vortex Oil Drinkers to remove floating oil from water. All products of the Canning Group will be available in France, including treatment equipment for industrial effluents and public water supplies. The European marketing activities will be controlled through Canning International BV, Amsterdam. Penguin Pumps Limited joined the Canning Group in 1970 as a subsidiary of Canning effluent treatment specialists, Pollution Control Limited. The present move brings together the group's pump manufacturing activities. In the near future the group will manufacture some pumps made entirely of plastic for handling chemicals over a wide temperature range.

J044

POLLUTION CONTROL PLANT STATISTICS,

Water and Pollution Control, Vol. 115, No. 11, p 78-96, 98, 101-102, November, 1977. 13 tab.

A comprehensive listing of Canadian municipal water pollution control facilities is provided in tabular form. The information given for each facility includes population size, whether the municipality has an industrial waste strength limiting by-law, average daily flow, and whether the system is separate or combined. Information on the degree of treatment, influent and effluent BOD and suspended solids, type of treatment, sludge processing, and cost of treatment per million gallons of waste water processed is also provided. Types of treatment covered include: algae lagoons, aerated lagoons, anaerobic lagoons, primary sedimentation, conventional activated sludge, completely mixed systems, contact stabilization, biological filtration, extended aeration, and septic tanks. Sludge processing techniques include: heated digesters, drying beds, filtration, centrifuging, agricultural disposal, unheated digesters, incineration, liquid haulage, deep well disposal, and landfilling. Selected listings of key management and operating personnel responsible for pollution control at various locations in Canada are also provided.

J045

COST-EFFECTIVENESS OF ON-SITE AND COMMUNITY SEWERAGE ALTERNATIVES,

Troyan, J. J., and Norris, D. P.

Brown and Caldwell,
Eugene, Oregon.

Civil Engineering-ASCE, Vol. 47, No. 12, p 84-89, December, 1977. 3 tab.

Information pertinent to the cost-effectiveness analysis of sewerage systems for small communities and rural residential areas is presented. Selection criteria are established for eight alternative systems for on-site disposal and community collection, including: septic tank-soil absorption system, septic tank-mounted system, septic tank-evaporation-transpiration system, conventional gravity sewers, small-diameter gravity sewers, pressure sewers, and vacuum sewers. The feasibility analyses are based upon results of an inventory of soils, site characteristics, geology-hydrology, and climate. The inventory results are evaluated in conjunction with data on technical feasibility, environmental regulations, and unit costs. Advantages, disadvantages, and limitations of the on-site disposal and community collection systems are described.

J046
1978 SEWERAGE PROJECT FORECAST,

Western Construction, Vol. 53, No. 2, p 32, February, 1978.

Water project construction legislation, approved by the United States Congress, has allocated $24.5 billion to be appropriated over the next five years. According to the National Utility Contractors Association, the legislation will provide an economic boost to construction firms in 1978. The additional funding comes at the end of an $18 billion allocation established by the 1972 Clean Water Act. A study completed by the National Utility Contractors Association refuted the contention by the Environmental Protection Agency that collector systems are not a cost-effective approach to waste water management. The recent legislation mandates that more than 25% of the funds be used for the construction of collectors and interceptors, rehabilitation, or combined sewer separation. The appropriation is part of the 1977 Clean Water Act approved by Congress.

J047
THE BARCELONA CONVENTION AND ITS PROTOCOLS,

Lagrange, A. S.

Ministry of Foreign Affairs,
Rome, Italy.

Ambio, Vol. 6, No. 6, p 328-332. 1977. 8 ref.

The 1976 Barcelona Convention, in which 16 Mediterranean coastal countries participated, resulted in international agreements for controlling pollution in the Mediterranean Sea. Fifteen countries have signed agreements establishing the Convention as a framework for protection of the ocean from pollution, control of the dumping of pollutants by ships and aircraft, and regulation of pollution in the Mediterranean Sea by oil spills. Three categories of wastes were identified within the protocol regulating pollution by ships and aircraft. One category lists the various substances which are totally prohibited; the second details those pollutants which require a special permit from the appropriate authority before dumping; and the third category covers the general range of all other wastes and matter for which a general dumping permit is necessary. A list of totally prohibited pollutants, including acid and alkaline compounds, is currently under consideration for adoption. The second pollution abatement protocol adopted by the Convention establish[illegible] a regional data collection center and mandates international cooperation in controlling, monitoring, recovering, and identifying pollution caused by an emergency or accidental situations. No agreement could be reached among the participating countries on the control of land-based pollution sources.

J048

ENVIRONMENTAL POLLUTION CONTROL IN METROPOLITAN ATHENS,

Gilad, A.

Environmental Pollution Control Project,
Athens, Greece.

Ambio, Vol. 6, No. 6, p 350-354, 1977. 6 fig, 1 tab.

Water, air, solid waste, and noise pollution controls under consideration for Athens, Greece, are reviewed. A Greek Environmental Pollution Control Project, initiated in conjunction with the United Nations Development Program and the World Health Organization, was established in 1973 as an environmental data collection center and coordinator of pollution abatement policies. A liquid wastes disposal system is being developed based on analyses of municipal and industrial effluent data, water use, and the impact of effluent discharges on water quality. Bioindicators have also been traced in receiving waters to determine the long-term effects of effluent discharge. Noise level surveys were conducted in six areas of Athens to delineate noise sources. Traffic was found to be the major source of noise pollution; legislation is pending that will establish maximum noise levels. Disposal of solid wastes in sanitary landfills is considered the most economic alternative for pollution control. Studies were conducted on the disposal of industrial wastes and resource recovery of methane gas and scrap paper. The impact of air pollution on materials, archeological monuments, and public health was monitored; air pollution controls are under development.

J049

SEAWATER PLUS SEWAGE YIELDS LOTS OF THE FUEL GAS,

Machine Design, Vol. 50, No. 3, p 10, February, 1978.

A technique for hydrogen gas production by reacting sea water with molten ferrous iron in subsurface magma has been developed by Sandia Laboratories of Albuquerque, New Mexico. It is estimated that 500 lb/hr of hydrogen gas would be produced by pumping 150,000 lb/hr of water into basaltic magma at a temperature of 1,200 C. Hydrogen production in magma containing 2-12% ferrous iron can be increased by the addition of biomass to the water. Suggested souces of biomass are sewage sludge, waste byproducts from crop harvesting and processing, and seaweed. The cellulose of the plants releases its hydrogen during the reaction with the magma. The reaction of water containing 10% biomass with magma at 1,300 C would yield gases containing 10% hydrogen. Reduction of the magma temperature at 600 C would produce a higher methane gas contant. An annual production rate of 26 billion cu ft of hydrogen is predicted for large basaltic magma chambers with a 12% ferrous iron centent at 1,200 C. Magma sources are thought to be located approximately 2-3 km below the ocean floor, within the range of current drilling technology. Steam, a byproduct of the process, can be used in electrical power generation.

J050

ENVIRONMENTAL MANAGEMENT IN A MEDITERRANEAN PORT CITY: HAIFA,

Evan, H. Z.

Ambio, Vol. 6, No. 6, p 346-349, 1977. 2 fig, 1 tab.

A two-year experimental environmental management project conducted in Haifa, Israel, was co-sponsored by the Environmental Protection Service, the city of Haifa and the United Nations Environment Program. A municipal agency was established to monotor air quality, river and beach pollution, and solid waste disposal. The agency was also responsible for establishing industrial cooperation, urban planning studies, and information services to public and legislative bodies. Air quality management has focused on monitoring stations, emission inventory, microclimatic studies, and industrial stack emissions, especially during inversions. An autonomous River Authority has been proposed to prevent pollution of the Kishon River with agricultural and industrial wastes. A 1,000 ton/day recycling facility has been proposed as a solution to the diminishing sanitary landfill areas. Reduction of coastal pollution by tanker oil and bilge water has been attempted by the provision of cleaning facilities and increased surveillance. Urban planning has concentrated on limiting population densities and separating residential and industrial areas. Legislation has been introduced for the dissemination of information to the public and for administrating guidelines.

J051

COMPUTERIZATION AND AUTOMATION OF WASTEWATER SYSTEMS,

Hadeed, S. J.

Journal Water Pollution Control Federation, Vol. 50, No. 1, p 5-7, January, 1978.

The advantages of automatic or computer control of municipal waste water treatment facilities are reviewed. Automation of sewage treatment plants is recommended as a means of reducing labor costs and human error. Large-scale facilities and industries have converted to automatic control to increase equipment life, reduce instrument size and maintainence requirements, and conserve chemical and energy consumption. Computerized operations are capable of collecting and reacting to data from flowmeters, thermocouples, pressure meters, thermometers, and other metering units. Plant efficiency can be computer controlled by comparing collected data with current instrument readings. Equipment malfunctions can be detected and even avoided by automatic monitoring of instruments and plant processes. The quality and quantity of the effluent during each treatment process is monitored by sampling units. The evaluation of computer operation in municipal waste treatment plants is based on the efficiency of the automatic processes and the cost factors involved in automation. An alternative for small treatment plants is the installation of a time-sharing terminal for data collection and analysis.

J052

SUBMISSION BY THE INSTITUTE OF WATER POLLUTION CONTROL TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION ON 'ENVIRONMENTAL POLLUTION AND AGRICULTURE',

Water Pollution Control, Vol. 76, No. 4, p 505-510, 1977. 1 fig, 3 tab, 17 ref.

Water pollution in agricultural areas and water supplies contributed by farm wastes and other sources is examined. Farm land application of treated and untreated sewage sludge is a suitable method of fertilization when the microbial and chemical contents of the sludges are monitored. An estimated 4% of the nutrients required for agricultural fertilization in England could be supplied by the phosphorus and nitrogen values in sludge. Limitations are recommended for levels discharged into the receiving soils of metals and boron because of their phytotoxic characteristics and potential harm to the food chain. Other pollution sources in agricultural land are spray irrigation waters containing chloride, boron, salts, trichlorobenzoic acid, and cadmium. Agriculture can contribute to water pollution by leaching of inorganic nitrogen and other fertilizers, and organic farm wastes.

J053

FUTURE TREATMENT PLANT REQUIREMENTS,

Macleod, D. C.

Water Pollution Control, Vol. 77, No. 1, p 20-24, 1978.

Supplementation of South Africa's potable water resources with treated municipal and industrial wastes is considered. Protection of river catchments which provide potential water supplies is recommended to prevent pollution by waste discharges. Waste water which contains difficult to treat but environmentally safe substances can be discharged to catchments which are not potential water sources. To maintain the quality of inland waters, tertiary treatment must be included in future waste water treatment plants; algal growth potential must be controlled below 25 mg/liter by nutrient removal. Nitrogen and phosphorus removal from waste waters is an important consideration in preventing algal blooms which clog filters in waste water treatment facilities. Landfill leachates and heavy metals from industrial, domestic, and municipal wastes should be controlled at the source before pollutants accumulate in the water supplies. Suspended solids and virus reductions can be achieved through natural self-purification in water bodies by locating waste discharge points a proper distance from the water supply. Disinfection by ozonation, chlorination, and other chemical treatments needs to be further investigated in relation to future water supplies.

J054

POLLUTION CONTROL IN THE BALTIC IS RESULT OF COOPERATION,

Water and Wastes Engineering, Vol. 15, No. 4, p 23, April, 1978.

Baltic Sea countries have reached agreements on the control of pollution entering the sea from municipal and industrial sources. Inadequately treated municipal sewage, agricultural runoff, and wastes from paper, shale oil, and chemical industries are the primary sources of pollution in the Baltic Sea. Tallinn, Estonia, discharges domestic sewage directly into the Baltic without treatment; Leningrad, U.S.S.R., treats one-third of its sewage before discharge to the Bay of Finland. Regulations limiting the discharge of sewage containing BOD, nitrogen, and ammonia are based on the waste assimilative capacity of the receiving body of water. The establishment of biological and chemical secondary treatment facilities has been initiated. Industries in the Soviet Union are now required to remove carcinogens and other toxic materials from waste water before discharge to a water body or treatment facility. Removal of nitrogen, phosphorus, and fertilizers from agricultural runoff has been required by the Soviet Union; DDT has been banned. Water consumption has been reduced through reuse in industrial operations.

J055

LANDMARK TEXAS DECISION AGREES BENEFIT IS NOT WORTH THE COST,

Taylor, T. E.

Department of Water Utilities,
Dallas, Texas.

Water and Wastes Engineering, Vol. 15, No. 4, p 26-29, April, 1978. 2 fig.

The Texas Water Quality Board relaxed the standards for advanced treatment of waste water in response to hearings conducted in 1977. The Board had adopted waste water treatment standards of 5 mg/liter BOD, 5 mg/liter total suspended solids, and 3 mg/liter ammonia-nitrogen. Treatment facilities costing $250 million were under construction in the Dallas and Fort Worth area to attain water quality standards of 10 mg/liter BOD and 10-15 mg/liter total suspended solids which were required by other Texas cities. These standards represented a 96% pollutant removal, whereas the more stringent regulations corresponded to 98% removal. Testimony during the hearing on the standards revealed that an additional $100-600 million would be required to upgrade and maintain the treatment plants to meet the strict standards. Other reports indicated that the quality of the river receiving the treated effluent would not be significantly improved by the measures until other nonpoint pollution sources were controlled. The Board voted to accept the 10 mg/liter BOD and 15 mg/liter total suspended solids regulations.

J056

CONSERVE ENERGY IN WASTEWATER SYSTEMS,

Foster, W. E.

Black and Veatch, Consulting Engineers,
Detroit, Michigan.

Water and Wastes Engineering, Vol. 15, No. 4, p 20-23, April, 1978.

Recommendations for the energy-efficient design of waste water treatment facilities are presented. Alternatives to direct firing of fossil fuels are electricity, solar energy, and heat pump recovery techniques. Oxidation ponds, fixed media filtration, anaerobic digestion, and land application of sludge require less energy than other treatment methods. Constant capacity pumps are more efficient than variable speed units; continuous flow requires less energy for warm-up or idle than intermittent operation. Mixing of primary anaerobic digestors is more efficient and the greater volume of gas produced can be stored for use in internal combustion equipment. Limiting the chemical doses of lime, ferric chloride, or polymer in sludge conditioning and designing efficient conditioning tanks can improve the properties of the sludge for later disposal. The reduction of dissolved oxygen levels in activated sludge and nitrification systems, excess air in the incinerator, and sludge pumping from the settling tanks effectively reduces energy requirements. Energy efficiency can be maintained in treatment buildings by reducing ventilation, temperature, and light, in non-critical areas, and by providing an elevated tank for the plant water system. Further energy savings can be attained by recovering all heat sources in plant operation.

J057

LEGISLATION NEEDED TO PROMOTE CONSERVATION AND RECYCLING,

Wilson, D. G.

Massachusetts Institute of Technology,
Cambridge,
Systems and Design Division,
Department of Mechanical Engineering.

Compost Science, Vol. 18, No. 4, p 13-15, July-August, 1977.

Legislation for regulating environmental pollution proposes that polluters be charged for sewage treatment and those who are affected by the pollution be compensated. An increase in sewer charges is recommended so that adequate waste water treatment can be accomplished. Suggested charges are based on the amount of waste water produced by an individual rather than evenly distributed charges. While sewer charges are usually based on water intake, individuals using water for non-polluting practices, such as irrigation, should be credited rather than taxed for this water usage. Individual waste production charges would encourage the use of water-saving and non-polluting devices, such as composting toilets. Where adequate sewage treatment is unfeasible, it is recommended that waste water charges continue to be collected and utilized in a compensatory fashion. This would include improvement of water supply and recreational facilities for communities located downstream from a pollution source. Long-term effects of pollution may be compensated for by creating national parks or wildlife centers. Other areas affected by pollution that are considered by the proposed legislation include natural resources, air pollution, and water supplies.

J058

CHLORINATION: ASSESSING ITS IMPACT,

Winklehaus, C.

Journal Water Pollution Control Federation, Vol. 49, No. 12, p 2354-2357, December, 1977.

The 'Second Conference on Water Chlorination: Environmental and Health Effects' was held in Gatlinburg, Tennessee, during November 1977 under the sponsorship of the Oak Ridge National Laboratory, the U. S. Environmental Protection Agency, and the U. S. Department of Energy. Topics covered by the 65 papers presented during the conference included: freshwater systems, marine systems, toxicity, trihalomethanes, waste water disinfection, industrial wastes, health effects, alternatives, and legislation. An EPA overview of the regulatory aspects of chlorination cited the flexibility in coliform standards for secondary waste water disinfection as responsible for the reduction in the increased use of chlorine. EPA officials favored improving water and waste water treatment processes used prior to disinfection as a means of reducing the disinfectant doses required to achieve adequate pathogen control. EPA-sponsored projects on alternatives to chlorine, such as ozone and bromine chloride, were highlighted during a separate session. Papers on the health-related aspects of chlorination focused on the carcinogenicity and mutagenicity of chlorinated waters as evidenced by epidemiological studies.

J059

PRELIMINARY LISTING OF MUNICIPAL WASTE WATER TREATMENT CAPACITIES,

1976. 187 p, 50 tab. NTIS Technical Report EDA-OER-76-038.

A preliminary listing of all municipal waste water treatment facilities servicing populations over 2,000 in the United States was compiled. The updated listing was devised by the Oklahoma Foundation for Research Development Utilization, Inc. for the Economic Development Administration. The municipal treatment facilities, categorized by state and county, are evaluated for the population served, based on data from the 1970 census. Municipalities within counties located in Economic Development Districts are noted. Each plant is classified according to the daily treatment capacity, the average daily use, the average daily per capita use rate, and the percentage of treatment facility capacity utilized. Predicted parameters recorded in the preliminary listing include the population expansion permitted by the present facility's design capacity, the estimated cost of expanding the plant for a utilization rate of 70% with a 20% impact margin, the use of the system approaching capacity or beyond capacity, and a reference number for each municipal facility. The second phase of this project, planned for 1977, will correct, update, and refine the data.

J060

CANADIAN GOVERNMENT APPROVES $66 MILLION LOANS TO MONTREAL FOR SEWAGE TREATMENT PROJECT,

Water and Pollution Control, Vol. 116, No. 1, p 17, January, 1978.

The Canadian government, through the Central Mortgage and Housing Corp., has loaned the Montreal Urban Community $66,660,400 for improvement of its municipal sewage collection and treatment system. Twenty-five percent of this loan, or $16,665,100, does not have to be repaid by Montreal. The loan is part of the $1.2 billion required for the upgrading of Montreal's sewerage system. Two-thirds of the total funding will be furnished by the Central Mortgage and Housing Corp. Loans totalling more than $231 million have been awarded to the Montreal Urban Community since 1974. The most recent loan will be used to purchase the land for a waste water treatment plant and for awarding contracts for its construction. Of the total cost of the project, $22 million was for the construction of an 11-ft diameter sewage collector tunnel. The Canadian government has awarded more than $1.5 billion to over 3,700 projects; 700 projects in Quebec have received $356 million, of which $67 million does not have to be repaid.

J061

1984 IS APPROACHING--WHAT DOES IT MEAN TO THE WASTE-WATER SERVICE?,

Crossley, A. M.

Metropolitan Public Health Division,
Thames Water Authority,
London, England.

Water Services, Vol. 81, No. 978, p 475-476, August, 1977.

Future trends in municipal waste water treatment facilities are predicted. Treatment facilities will reportedly be automatically controlled and operated by a main computer. Log sheets and records will be maintained by the computer for read-out on a visual display unit or on tape. The computer will control plant maintenance schedules as well as security and personnel matters. Magnetic or ultrasonic flowmeters and level transmitters will monitor waste water and sludge flows. Floats and electrodes in pumping stations will be replaced by upstream level meters; pumping operations will be controlled by integrated solid state circuit chips. The computer will automatically regulate the dissolved oxygen secondary treatment process by evaluating data from electrodes. Digesters will be operated according to the quantity and rate of gas production, measured by the BTU or heat meter. Fuel to power the treatment facility, as well as excess fuel for local power stations, will be supplied in the form of methane from the digesters.

J062

DIRECT ENVIRONMENTAL FACTORS AT MUNICIPAL WASTEWATER TREATMENT WORKS--EVALUATION AND CONTROL OF SITE AESTHETICS, AIR POLLUTANTS, NOISE AND OTHER OPERATION AND CONSTRUCTION FACTORS,

Leffel, R. E.

1976. 111 p, 20 fig, 14 tab, 104 ref, 1 append. Technical Report EPA-430/9-76-003.

Methodologies of municipal waste water treatment plant design evaluation and planning in compliance with the Federal Water Pollution Control Act Amendment of 1972 (P.L. 92-500) were developed to assist treatment plant designers in achieving cost-effective and environmentally sound projects. Planning and design controls are reviewed for treatment plants, pumping stations, separation structures, interceptors, force mains, collection systems, and outfall sewers. Criteria for controlling noise and air pollution, and providing aesthetic lighting, architecture, site design, and landscaping are presented. Environmental impacts considered in project planning include wildlife, shorelines, wetlands, flood plains, drainage, and construction and operation effects. A compilation and review of reference legislation affecting waste water treatment plants is included in the guidelines.

J063

FINAL ENVIRONMENTAL IMPACT STATEMENT--CITY OF JACKSONVILLE, FLORIDA WASTEWATER MANAGEMENT FACILITIES, ARLINGTON-EAST SERVICE DISTRICT,

1976. 245 p, 15 fig, 1 tab. Technical Report EPA-904/9-76/021.

The final Environmental Impact Statement on the specifications of the 10 mgd regional waste water treatment plant planned for Jacksonville, Florida, was presented by the U.S. Environmental Protection Agency as a preliminary to awarding grants for funding the project. In addition to the waste water treatment plant, the project included 13,900 ft of outfall line to the St. Johns River and a 38,000 ft force main for pumping sludge to an incinerator. The impact of construction activity on aquatic animals in two salt marsh ponds, on wildlife, and on the surrounding communities was reviewed. The effects of the discharge of 10 mgd of treated effluent on the St. Johns River and the community development associated with the expanding waste water treatment facilities were evaluated. The alternative sites for the treatment plant, outfall, and force main were considered on a cost-effective basis. The Environmental Impact Statement is a continuation of a draft presented in 1976.

J064

NEW PROSPECTS FOR SEWAGE DISPOSAL IN U P,

Chaturvedi, A. C.

Irrigation Commission,
Lucknow, Uttar Pradesh, India.

Journal of the Institution of Engineers (India), Vol. 58, Part EN 1, p 21-22, October, 1977.

Sources of water pollution in Uttar Pradesh, India, are identified and water quality controls are cited. The discharge of sewage effluents to rivers, ponds, and lakes has overburdened the natural self-purification process of receiving waters. Surveys have indicated that waste water treatment facilities should be expanded or replaced; further research on pollutant identification and water basin management is recommended. Identification of a water resource's use is required for the cost-effective evaluation of the need for treatment facilities, reservoirs, sewer systems, and control regulations. Trace quantities of pollutants have been identified as leading to hematopoitetic tissue. More strict control of halogenated methanes and chloroforms in receiving waters is needed; organic components in domestic wastes have been classified as carbohydrates, proteins, fatty acids, and soluble organic materials evident in trickling filter effluent. Effective water quality management includes establishing standardized rating scales, information resources, nutrient requirements of aquatic flora, and cost-effective alternatives of waste water treatment projects.

J065

THE PROVISION OF TECHNICAL INFORMATION IN A REGIONAL WATER AUTHORITY,

Mathews, M. G., and Hilder, D. W.

Severn-Trent Water Authority,
Birmingham, England.

Journal of the Institution of Water Engineers and Scientists, Vol. 32, No. 1, p 7-18, January, 1978. 1 fig, 5 tab.

Guidelines for water quality data collections and analyses are described for regional planning and records maintained by water authorities. The guidelines are categorized as: water resources, land drainage, reclamation and trade effluent control, water supply, sewerage, general engineering, planning and design, water quality management, recreation, fisheries, and medical. Continuous monitoring of water in water supply sources, waste water treatment plants, and rivers is recommended; samples are referenced according to site, date, time, and type of analyses to be performed. Background information suggested for sewage works includes: flows, discharges, pumping information, economic history, physical statistics, and a complete record of sewers. Further information required for treatment plants involves: the chemical, biological, and bacteriological data; and trade effluent details, such as the strength and volume of the waste, as well as charges and rebates. Computers are forwarded for collating, analyzing, and storing the regional water authority data.

J066

CONDUCTING VALUE ENGINEERING STUDIES--THE EXPERIENCE OF FIVE CITIES,

Culp, G.

Culp, Wesner, Culp, Clean Water Consultants,
El Dorado Hills, California.

Water and Sewage Works, Vol. 125, No. 2, p 56-60, February, 1978. 6 tab, 1 ref.

Value engineering reports, required by the EPA for all waste water treatment projects costing more than $10,000, and the subsequent cost reductions of constructing municipal waste treatment plants were reviewed for five cities in which value engineering was employed. The value engineering report on the upgrading of a 3 mgd trickling filter plant indicated a cost savings of $3,843,570, of which $920,000 was implemented. An evaluation of a 70-80% completed 24 mgd activated sludge plant indicated a cost savings of $547,467, of which $274,770 was realized. The third plant, upgraded from 1.6-3.8 mgd capacity, saved $1,404,872 with value engineering. Upgrading of a 115 mgd treatment plant to 200 mgd with nutrient removal operations cost $5,700,000 less than estimated. The fifth project, in which two plants with a total capacity of 250 mgd were upgraded to provide nitrification and improved effluent quality, was evaluated as costing $43,600,000 less than estimated; $9,318,000 was saved in construction costs when value engineering was implemented. The value engineering fees ranged from 0.2-0.8% of the total construction costs for each of the five projects.

J067

REUSE, ENERGY, SLUDGE: IN WHAT DIRECTION ARE WE GOING?,

Greifer, L.

Water and Wastes Engineering, Vol. 15, No. 1, p 37-38, 40, 42-44, January, 1978.

Pilot plant studies and current waste water treatment practices are reviewed for the reuse of waste water and energy generation from sludge disposal techniques. The Odessa, Texas, sewage treatment plant discharges its wastes to a secondary treatment facility in a petrochemical plant which uses the treated water as cooling tower makeup and boiler feed water; the petrochemical wastes are recharged into injection wells for oil production. An Israeli pilot plant recharges the waste water into potable aquifers after oxidation lagooning, lime conditioning, clarification and chlorination; the recharged water is used for irrigational and industrial purposes but also fulfills potable water standards. Autothermic copyrolysis of sewage sludge and refuse-derived rather than fossil fuel required a fuel-to-sludge ratio of 1:2 and a sludge solids content of 24%. Orange County, California, has utilized digester gas and waste heat from secondary treatment operations with a fuel value of 600 BTU/cu ft as a power supply. A comparison of pyrolysis and incineration in Arlington County, Virginia, indicated that pyrolysis required lower temperatures and less combustion air, while producing enough steam to power the afterburner. Pyrolysis in conjunction with activated carbon reduced suspended solids by 95%, grease to 10 mg/liter, BOD above 30 mg/liter, and heavy metals by 75.0-99.9%. Co-incineration of sludge and refuse produced 150,000 kilowatt hrs/day of power. Viruses in sludge supernatant were disinfected within 3 days at 35 C. Land application, pH adjustment, and ocean disposal of sewage sludge were also reviewed.

J068

WATER REORGANIZATION--AIMS, ACHIEVEMENT AND THE FUTURE,

Sinnott, C. S.

Thames Water Authority,
London, England.

Effluent and Water Treatment Journal, Vol. 18, No. 2, p 73, 76-77, 79, February, 1978.

Improvements in waste water quality enacted by England's Thames Water Authority since its inauguration in 1974 are reviewed. An 8,300 million gallon reservoir, completed in 1976, and the Lambourn valley groundwater plan augmented the water supplies during a drought. A complete sewage treatment plant was constructed at Beckton to improve the quality of effluent flowing into the Thames River. Carrousel waste water treatment systems were installed in Ash Vale and Shroncote to assist the overloaded treatment plant in Farnborough, Hampshire. Secondary treatment operations were installed in the Long Reach works where primary treated effluent was polluting an estuary. High nitrate concentrations in the Lee River, supplying 7% of the water for the Thames region, were reduced by constructing a denitrifying plant at Luton Sewage Treatment Works and converting an activated sludge plant to reduce nitrates at Rye Meads. A total of 19.25 million pounds sterling will be spent on treatment systems, pumping plants, and sewers in Southwark and Beckton to accommodate the increasing population in the redeveloped Docklands. The capacity of the Fobney Water Works on River Kennet will be increased by 10 mgd to accommodate developments and industries in the Basingstoke-Reading area. The Reading treatment plant will be expanded from 11 to 14 mgd with a two-stage activated sludge operation using pure oxygen injection and surface aeration for nitrification.

J069

COUNTRIES RESEARCH WASTE TREATMENT AND FISH FARMING,

Water and Wastes Engineering, Vol. 15, No. 3, p 63, March, 1978.

A research project on the feasibility of utilizing sewage stabilization ponds for fish farming has been supported by institutions in Israel, Kenya, Thailand, Malaysia, and Peru. The stabilization ponds, averaging 1.5 m in depth, promote bacterial and algal growth in a warm and sunlit environment. Fecal coliforms are reduced by 98% in stabilization ponds due to other predatory organisms, the physical conditions in the ponds, and the lack of nutrients. The research will examine the uptake of heavy metals and pesticides by fish and the transfer of pathogens on the scales or in the gut of fish. Stabilization pond design, operation, and quality may have to be altered from the conventional rapid treatment and discharge of waste water to accommodate fish production. Considerations include the type and concentration of the wastes and nutrient levels required for fish growth.

J070

POINT-OF-USE WATER TREATMENT ALLOWS SELECTIVITY,

Water and Wastes Engineering, Vol. 15, No. 3, p 56, March, 1978.

Point-of-use waste water and potable water treatment systems are reviewed as an alternative to centralized waste water treatment facilities and water supply connections. A municipal waste water treatment facility for two towns in Minnesota, eligible for 80% EPA funding, cost an estimated $2,800,000 for a stabilization pond, sewers, a pumping plant, and other treatment equipment. The sandy loam soils in the two areas were reportedly suitable for septic tanks and soil treatment units costing an estimated $1,500-2,000/lot. If the homeowners would have been required to pay 20% of the per capita costs of the centralized treatment plant, they would have had to pay $2,000 more than for a septic tank system. The example was used to demonstrate the need for investigation of point-of-use waste water treatment. Point-of-use treatment was also applied to potable water. In the example cited, connection of a remote farm to a centralized water supply cost an estimated $2,350 more than drilling a private well and installing water treatment equipment. In this case, point-of-use water treatment system operation cost an estimated $520/yr less than equivalent water usage charges.

J071

USER ACCEPTANCE OF WASTEWATER SLUDGE COMPOST,

Ettlich, W. F., and Lewis, A. E.

Culp/Wesner/Culp, Clean Water Consultants,
El Dorado Hills, California.

1977. 54 p, 2 fig, 6 tab, 7 ref, 6 append. Technical Report EPA-600/2-77-096.

An investigation of consumer attitudes toward waste water sludge compost utilization and past and current distribution practices was conducted. Interviews were performed with compost users in areas which produce and distribute composted waste water sludge. Usage interviews were conducted in Placerville, California; Colorado Springs, Colorado; Fort Worth, Texas; Washington, D. C.; Los Angeles, California; and Chicago, Illinois. Results of the interviews indicated a willingness by users to accept composted sludge providing it cost no more than current products and could be tested prior to use. Sludge transportation costs, based on data collected from the Chicago composting operations, were $2.50/cu yd sludge for 28 miles, one way, and $1.30/cu yd for 8 miles, one way. Expected user pick-up of composted sludge in the interviewed areas ranged from 75-100% of the sludge volume produced.

J072
RETROSPECTIVE ASSESSMENT OF WASTEWATER TECHNOLOGY IN THE UNITED STATES 1800-1972,

Tarr, J. A., McMichael, F. C., McCurley, J., Yosie, T. F., and McShane, C.

Carnegie-Mellon University,
Pittsburgh, Pennsylvania,
Department of History.

1977. 367 p, 15 fig, 10 tab, 422 ref, 4 append. NTIS Technical Report NSF/RA-770351.

The historical development of water supplies and waste water treatment was examined by methods of retrospective and prospective analysis. It was hypothesized that initial attempts at instituting water quality standards and controls paralleled water quality developments since 1960. A review of technologies developed since 1800 includes: water-carriage collection systems, separate or combined sewerage, and waste water applications to land. Water quality policy and conflicts, social impacts and values regarding waste water management, federal roles, policy, programs relating to water quality, and health and economic impacts are examined. Relevant historical and contemporary technological comparisons are highlighted. The study concluded that waste water technology has transferred pollution sources from the municipalities due to the negative impacts of certain capital-intensive technologies on second parties; retrofit of in-place, capital-intensive technology has limited waste water treatment techniques; social values have been affected by the negative and positive aspects of waste water technology; and retrospective examination of water quality technology can be a useful instrument in formulating contemporary and future water policies and technologies.

J073
LAND TREATMENT OF SEWAGE: EPA'S VIEW,

Reid, F.

Water and Sewage Works,
Chicago, Illinois.

Water and Sewage Works, Vol. 125, No. 4, p 64-67, April, 1978.

The EPA's policies on land treatment of waste water by rapid infiltration, groundwater recharge, and vegetation fertilization are reviewed. The use of primary-treated, secondary-treated, or mixed wastes in land application is influenced by the type of waste, local soil, application method, and area topography. EPA policy emphasizes the need to examine the constituents of municipal wastes in evaluating treatment requirements. Land application of pure domestic wastes removes and utilizes up to 99% of the nutrients and other waste products. Municipal wastes containing nondegradable household detergents may require pretreatment before land application; food processing wastes are usually amenable to land application without pretreatment. Variables influencing land treatment include climate, soil condition, and height above groundwater. The statutes adopted by EPA give preference to land application when it is a cost-effective alternative to other treatment systems. About 15% of the grants that have been issued by the EPA have funded land application systems, primarily in small communities. Although pretreatment may reduce the cost-effectiveness of land application, the same would be required before discharging wastes into receiving waters. Land treatment has the additional benefit of supplying nutrients and is not as energy or chemically intensive as advanced waste water treatment methods. The EPA policy on land treatment also considers the advantage of producing recoverable water by this method.

J074

CMS SYSTEM SAVES TIME AND MONEY,

Water and Wastes Engineering, Vol. 15, No. 5, p 76, May, 1978.

Construction management services supplied by CH2M Hill permitted a 16% savings and early completion of the Rock Creek sewage treatment plant, commissioned by the Unified Sewerage Agency of Washington County, Oregon. The plant, which provides primary, secondary, and tertiary treatment, was completed on a phased design and construction system. Construction contracts were divided into 50 separate packages; major equipment was ordered directly from the manufacturers. The project was divided into three phases: the raw sewage pumping plant, the primary treatment facilities, and the secondary-tertiary treatment facilities. Phased design and construction permitted earlier startup than would have been possible with conventional design-bid-construct systems. Phased design also permitted earlier equipment orders and deliveries; inflation associated with project construction costs was reduced because of the shorter and earlier construction time. Initial designs were developed in March, 1975; the entire tertiary operation was completed in November, 1977, 9 months ahead of schedule.

J075

ESTABLISHING GUIDELINES FOR LAND-BASED WASTE MANAGEMENT PLANNERS,

Baker, M., and Christensen, L. A.

Water and Sewage Works, Vol. 125, No. 4, p 76-80, April, 1978. 1 fig, 1 tab, 11 ref.

Technical, economic, legal, and socio-political considerations are incorporated into a design framework for sewage sludge treatment and disposal decision making. Alternative methods of waste treatment should be evaluated with cost-benefit analyses. Resource recovery and land application of waste water treatment residuals can be encouraged through government policies, reducing depletion of certain natural resources. This can be accomplished through legal regulations or through an economic incentive program. Fee simple title and ownership, easements, leases, and other contractual arrangements are the alternatives cited for land acquisition and management. Other considerations incorporated into the decision framework are transport, other types of recycling processes, management objectives, and revenue producing alternatives.

J076
SEWERAGE FOR DEVELOPING COUNTRIES,

Pickford, J.

University of Technology,
Loughborough, England,
Department of Civil Engineering.

Effluent and Water Treatment Journal, Vol. 18, No. 3, p 119-120, 122-123, 127, 129, 1978. 3 fig, 1 tab, 11 ref.

Social and economic factors are considered in alternative sewerage designs for developing nations. In some countries, sewer systems constructed in the 19th and early 20th centuries are still in operation. An estimated 140 million people in developing countries have no sanitary or sewerage provisions. Only about 3% of the population in developing countries is serviced by sewers that connect to treatment facilities; an estimated 200 million have household sewerage systems, ranging from septic tank systems to pit or bucket latrines. Economic situations in developing countries may limit sewer installation in many areas; water supplies to remove wastes are also inadequate in many parts of the world. Blockage and septicity in sewer systems are common problems in tropical countries. Conventional sewerage is often feasible only in industrial areas or in commercial and higher class residential areas. Modified sewerage is applicable in areas where housing is under construction and a system can be installed simultaneously. Rural, low-density, and transitional districts are more amenable to on-site household treatment systems. In overpopulated urban areas, high density villages, or transitional districts, communal latrines or vacuum truck systems can provide waste removal in the absence of adequate drainage and disposal land.

J077
WASTEWATER PLANT CONSTRUCTION,

Environmental Science and Technology, Vol. 12, No. 5, p 512-513, May, 1978.

A three-year agreement between the EPA and the United States Army Corps of Engineers provides construction evaluation, management, and supervision of waste water treatment projects funded by the 1977 Clean Water Act. The Act will supply $24.5 billion in grants for municipal waste water treatment projects, incorporating a three-phase grant process. The process includes an initial facility plan developed locally, a more detailed plan with designs and specifications, and a final construction and operation phase. Corps personnel assigned to the EPA construction grant program are responsible for the engineering feasibility studies. Bid and construction plans are evaluated by the Engineers' assessment of the submitted plans and specifications. When a project is funded, Corps personnel will be maintained on-site to indirectly manage the construction projects; projects funded for more than $50 million will have a full-time Corps supervisor.

J078

BETTER O AND M PROGRAMS IS ULTIMATE ANSWER TO O AND M PROBLEMS,

Davanzo, A. C., and Thompson, W. B.

Detroit Water and Sewage Department,
Michigan.

Water and Wastes Engineering, Vol. 15, No. 3, p 22-23, March, 1978.

Camp, Dresser and McKee of Boston, Massachusetts, were retained by the Detroit Water and Sewerage Department to formulate operation and maintenance manuals and train personnel employed in the new 800 mgd waste water treatment plant. The plant has a maximum capacity of 1,200 mgd and a staff of 500 people employed over three shifts. The plant provides primary treatment, secondary aeration treatment, chemical flocculation for phosphorus removal, scum and grease removal, clarification, and incineration. Operation and maintenance priorities were identified for certain sludge treatment and disposal operations where effluent quality standards were threatened; manual preparation and personnel training were initiated in these areas. Final manuals describing operation and maintenance guidelines for all processes will be assembled into a comprehensive volume. Training and evaluation of the personnel will culminate in testing that will include both written and practical examinations. In-plant training programs are also being established to educate new employees, as well as maintain and update the operation and maintenance manuals as required.

J079

SEWAGE SLUDGE - WASTE OR AGRICULTURAL ASSET?,

Coker, E., and Davis, R.

Soil Science Section,
Water Research Centre,
Stevenage, England.

New Scientist, Vol. 78, No. 1101, p 298-300, May, 1978. 1 fig, 1 tab.

The use of sewage sludge as an agricultural fertilizer is reviewed as an alternative method of disposal. Liquid sludges, with high soluble nitrogen concentrations, can be applied to crop and pasture lands by spray irrigation; they generally contain higher levels of nutrients than solid sludges. Solid sludges must be ploughed into fields but contain higher levels of organic material. England's Department of the Environment, the National Water Council, and the Agricultural Development and Advisory Service have recommended that a Cu:Ni:Zn ratio of 2:8:1 be maintained when adding sludge to soils. Standards for As, B, Cd, Cr, Hg, Mo, Pb, and Se in sewage sludge and soils have also been proposed. Guidelines on sludge application rates to crop lands define the amount of nitrogen to be added to soils to maintain the proper balance. Salmonella, Taenia saginata, Heterodera rostachiensis, and other pathogenic or infectious organisms should be reduced or removed. Grazing on land treated with raw sludge should be delayed for six months; pasture lands receiving treated sludge should not be used for three weeks. When treated sludge is applied to land that will be planted with crops that are eaten raw, planting should be postponed until one year after sludge application.

J080

WATER-CONSERVATION METHODS TO MEET PENNSYLVANIA'S WATER NEEDS,

Fletcher, P. W., and Sharpe, W. E.

Pennsylvania State University,
University Park,
Department of Forestry.

Journal of the American Water Works Association, Vol. 70, No. 4, p 200-203, April, 1978. 11 ref.

Sources of potential water conservation in Pennsylvania are reviewed with respect to reducing the load on sewage treatment plants and residential waste water treatment sites. Water-saving devices attached to showerheads, toilets, and sinks can reduce water closet water use to 3.5 gal/flush, compared to the conventional 4-6 gal, and shower water discharge to 3.5 gal/min, compared to the conventional 4-10 gal/min. Pressure-reducing valves can be installed to reduce residential water pressure to 340-410 kPa. Compressed air-assisted showers and water closets can reduce water consumption to 0.5 gal/min and 0.5 gal, respectively. Water saving devices can reduce sewage flows to the treatment plant by up to 7% and flows to residential on-lot disposal fields by 40%; infiltration-inflow comprises about 30-40% of the treatment plant influent, necessitating sewer line studies and corrections. Further water and energy saving techniques can be applied to dishwashers, clothes washers, and water heaters.

J081

CURRENT STATUS OF ON-SITE WASTEWATER MANAGEMENT,

Senn, C. L.

Journal of Environmental Health, Vol. 40, No. 5, p 279-284, March-April, 1978. 2 tab.

Current planning techniques and regulations governing on-site waste water treatment facilities are reviewed. Zoning and land use planning are recommended before land development begins; soil topography, geology, aquifer, vegetation, and climate analyses are initial considerations in regulating on-site sewage systems. Building permits should be issued by building and plumbing regulatory agencies before actual on-site systems are constructed to insure that proper design criteria are met and site characteristics are suitable. The Manual of Septic Tank Practice has modified the design criteria for on-site treatment; other methods of residential waste treatment include aerobic treatment, soil absorption-evapotranspiration, pressurized subsurface absorption, electric osmosis for impervious soils, waterless and water-conserving toilets, mound systems, and recycling systems. Absorption field design, septic tank design, and water depth parameters mandated by various state agencies are presented; land use planning practices and regulations adopted in some states are reviewed. The development of new on-site treatment methods and standardization of test methodology are recommended. The expanded requirements of on-site waste water treatment regulations are considered.

J082

COST STUDIES FOR RENOVATED WASTEWATER,

Clark, R. M., English, J. N., and Gillean, J. I.

Municipal Environmental Research Laboratory,
Environmental Protection Agency,
Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 50, No. 4, p 688-697, April, 1978. 18 fig, 9 tab, 8 ref.

An economic evaluation of three options for expanding the potable water supply in San Diego, California, and Dallas, Texas, included two in which waste water was renovated. The first scheme involved expanding the existing water supply source; a cost analysis concluded that this option would increase the total cost of water by 23.5% in Dallas and decrease the total cost by 3.4% in San Diego. The second scheme, in which treated water would be routed to an existing reservoir to supply up to 50% of the water demand, would cost Dallas an additional 46.5% and San Diego 41.7%. In the third option, waste water would be treated to higher levels in a renovation plant and directed to the inlet of the water treatment plant; total costs for this scheme would increase by 64.4% for Dallas and 52.0% for San Diego.

J083
DIESEL GENERATING SETS PROVIDE BACK-UP POWER,

Water Services, Vol. 82, No. 987, p 295-296, May, 1978.

Auto Diesels Braby Ltd. manufactures a variety of generators for use as standby power units in England's water and sewage treatment plants. The diesel generator units have power outputs ranging over 20-1500 kilovolt-amperes. The generators are available as mobile units or stationary models; weatherproof enclosures and optional soundproofing make the units suitable for a variety of residential or treatment plant conditions. The power units are equipped with either manual or automatic start-up control and may be used as power backups or primary power sources. Power frequencies range over 40-60 hertz to operate variable speed pumps; the diesel generators are usually installed as sets which operate separately or in parallel.

J084
SEWAGE COULD SPREAD HEALTH HAZARD,

New Scientist, Vol. 78, No. 1106, p 646, June, 1978.

Potential public health hazards are identified for the land application of municipal waste water and sewage sludge containing bacteria, viruses, parasitic protozoa and helminths. The increased use of sewage-derived organic fertilizers and incorporation of land application techniques into EPA construction grant policies may increase the potential for introducing pathogens into the soil. Conventional secondary waste water treatment and chlorination may not destroy all of the pathogenic or infectious agents; techniques for analyzing viruses are selective and may not identify all types present. Viruses have been shown to be resistant to many environmental conditions; poliovirus has survived for up to 36 days on lettuce and radish crops spray irrigated with waste water. Laboratory tests on pathogen viability in waste water after treatment have often overestimated the removal efficiency of the processes. Further biological, chemical, or physical stabilization processes are recommended for primary effluent and aerobically or anaerobically digested effluent. Caution is advised in the consumption of raw vegetables harvested within 2-3 mos of spray irrigation with sewage effluent.

J085
EPA AMENDS SEWAGE PLANT FUNDING RULES,

Engineering News-Record, Vol. 200, No. 25, p 41, June, 1978.

The EPA Has amended construction grant regulations for municipal sewage treatment plants in an effort to improve grant application processing procedures and to update the regulations to conform with 1972 amendments to the Federal Water Pollution Control Act. Equipment procurement practices will be modified and awarded construction grants will be cross-referenced with waste water permits. Enforcement practices will be coordinated with grant mechanisms to monitor construction schedules. Equipment costing less than $200,000 will no longer require commercial code equipment liens for progress payments. Retroactive applications based on inflationary increases prior to December 1975 will be eliminated. New provisions have been established for integrating specific treatment facilities with regional water quality. Proposed compliance with facilities planning requirements by March 31, 1980, will eliminate grace periods.

J086
JAPANESE GAS FROM SEWER SLUDGE,

Water and Waste Treatment, Vol. 21, No. 6, p 17, June, 1978.

An electric powerplant, developed by Ebara-Infilco of Tokyo, Japan, uses sewage sludge gas as its fuel source. The powerplant, reportedly capable of generating 170,000 kilowatts/1 mgd waste water, reclaims sludge gas in a high-efficiency sewage digestion chamber. Desulfurization and other methods remove hydrogen sulfide and other impurities from sludge digestion gas which is then stored in a pressure tank. The digester gas is burned in an engine designed and supplied by Motoren-Werke Manheim A. G. of Munich, West Germany. Combustion of the gas in the engine turns a generator turbine which generates electricity. The powerplant is equipped with a waste gas burning boiler which supplies steam to the digestion chamber. The plant is reportedly capable of supplying enough electrical power to operate all sewage treatment equipment, including the air blowers and pumps, in addition to generating surplus power.

J087
IWES 83RD SUMMER MEETING AND CONFERENCE, 1978,

Water Services, Vol. 82, No. 988, p 334-336, June, 1978. 1 tab.

The water quality of Welsh estuaries and coastal waters was one of the topics discussed at the 83rd IWES Conference. The Welsh Water Authority reported that about 65% of the 574,000 cu m/day sewage and 10,647,000 cu m/day industrial effluent produced in the area was discharged with little or no treatment to tidal waters. A 1975 survey indicated that of the 414.5 km of Welsh estuaries, 25.7 km were grossly polluted, 59.9 km were of poor quality, and 53.0 km were in need of some improvement. Wastes produced by about two-thirds of Wales population are discharged into the Severn Estuary and the Bristol Channel. Liverpool Bay receives domestic and industrial wastes from Lancashire; the Menia Straits receive sewage discharges totalling about 8,730 cu m/day at an average organic loading of 2,600 kg BOD/day. Guidelines were adopted by the Welsh Water Authority in 1975 for controlling domestic sewage and industrial waste discharges into tidal waters. The Working Party on Sewage Disposal concluded that screening and comminution of sewage rather than biological treatment was adequate for discharged waste water; suitable outfall design was also recommended. A directive on bathing water quality and a reservoir system on the River Dee for water augmentation were also discussed.

J088

SLUDGE GAS AN ENERGY SOURCE IN SEWAGE WORKS,

Bicknell, M.

Civil Engineering, p 61, 63, 65, May, 1978. 9 ref, 2 append.

The use of methane gas from sludge digestion is discussed as a fuel source for sewage treatment plant operations. A plant serving 1,000 people, utilizing sludge digestion tanks with a 30 day capacity of 82.5 cu m, can supply 30 cu m/day of digestion gas. The gas contains methane, carbon dioxide, and nitrogen, with a caloric value of 24.5 megajoules/cu m. While small plants may not economically utilize the surplus digestion gas produced, power costs to heat boiler water, which raises the sludge digestion temperature to 35 C, could be offset if the boiler system were expanded to also provide heating of offices and laboratories in small treatment plants. In larger plants serving a population of 100,000 people, digestion gas can be generated at a rate of 3,000 cu m/day at an available energy supply of 73,500 megajoules/day. Sludge digestion also has the advantage of easier sludge handling and may provide fuel for sludge incinerators.

J089

SEWERAGE STUDY HITS SOUTH TAHOE AWT COSTS,

Engineering News-Record, Vol. 201, No. 4, p 11, July, 1978.

South Lake Tahoe, Nevada, has been advised by the engineering firm of Culp, Wesner, Culp, of El Dorado, California, to convert from advanced waste water treatment to secondary treatment with irrigation disposal. Designs for expanding the 7.5 mgd tertiary treatment plant to 10 mgd demonstrated that secondary treatment with land application would require $20 million in capital expenditures and $1.4 million annually for operation and maintenance. This expense represents an annual savings of 27% plus an additional 50% energy consumption reduction. Nitrogen removal would require $32 million in capital expenditures and $2.7 million for maintenance; expansion to nitrification would require capital expenditure of $25 million with annual maintenance costs of $2.5 million. A 1 mgd reverse osmosis water reclamation demonstration plant in addition to secondary treatment and land application was also considered; capital and operating costs were estimated at $25 million and $2.5 million, respectively.

J090

MILWAUKEE'S LAST STAND - CITY FIGHTS ADVANCED TREATMENT ORDERED IN WATER CLEANUP SUIT,

Engineering News-Record, Vol. 200, No. 22, p 13, June, 1978.

The city of Milwaukee, Wisconsin, is fighting a federal decision on a suit brought against the city by Illinois and Michigan. The decision mandated that Milwaukee construct a tertiary treatment plant to accommodate all of its municipal wastes before discharge to Lake Michigan. Milwaukee contends that the construction costs would be excessive, $1.46 billion, and that the advanced treatment plant would require 11 yrs to complete. The city also claims that storm water tunnels and detention systems to reduce the 50 overflows in the lake occurring each year should have priority over the treatment system. Since Wisconsin water quality standards are lower than those in Illinois and Michigan, Milwaukee maintains that advanced treatment of waste water is not required; the EPA will refuse funding of the advanced waste water system and will only supply grants for treatment within Wisconsin's standards. An Illinois official has claimed that the costs reported by Milwaukee for the tertiary treatment are inaccurate and excessive. The court decision required that the treatment facility be completed by 1986.

J091

HOLLAND FIGHTS WATER POLLUTION,

Industrial Engineering, Vol. 10, No. 5, p 42-43, May, 1978.

Several of the Netherlands' 519 waste water treatment plants are described. The Eindhoven plant can treat waste water from a population of 750,000; sewage is transported to the facility through a 27.6 mile-long pipeline. The treatment plant's operations are controlled by a computer which collects plant data, performs impact and fluctuation calculations, and controls pipe flows and pumping operations. An underwater plant planned in Rotterdam will discharge fumes through a pipeline to a destructor. A number of plants utilize a patented water-jet aeration treatment system that simultaneously oxygenates and mixes the waste water. The Dutch State Mines have constructed an aeration system to convert organic wastes as well as inorganic nitrogen compounds into nitrogen. An industrial anaerobic digester has been designed by the Central Sugar Works. Some plants employ electro-flotation processes, sludge drying techniques, or sludge fermentation tanks for methane gas production. An automatic water pollution monitoring network collects data on water quality from a number of sources and issues short- and long-term alarms when quality is below normal.

J092
MUNICIPAL SEWAGE SYSTEM SPRINGS 20-25 MILLION GALLON PROBLEM,

Mackay, B. B., Jr.

Solid Wastes Management, Vol. 21, No. 7, p 56, 58, July, 1978.

The leakage of raw sewage and sludge from oxidation lagoons into groundwater caused the illness of 700 residents in the area of West Plains, Missouri, in June 1978. The oxidation lagoons, constructed in caverned and fissured limestone, developed holes soon after completion in 1964. The first hole, which developed in the lagoon before it was completely operational, was 17 ft in diameter and between 10-20 ft deep. A second hole, which was 34 ft wide and 10-20 ft deep, developed in 1966 and released about 40 million gal of sewage into the groundwater. Local authorities reportedly did not notify state agencies or the public of the leaks. The third leak occurred in May 1978 in the 37-acre lagoon; the local health department and the public were reportedly not informed of the new break in the lagoon until five days after it occurred. Residents in the town and surrounding area developed symptoms similar to dysentery and influenza. Water supplies had to be imported to the area by the National Guard. The lagoon was repaired before a geologic report was completed; a new treatment facility is planned for construction on the same site as the lagoons.

J093
THE WRC-WHERE THEY KNOW A BIT ABOUT WATER AND ARE LEARNING ALL THE TIME,

Surveyor, Vol. 4487, No. 151, p 17-19, June, 1978.

Waste water treatment, transport, leakage, and impact research projects have been conducted by the Water Research Center at Stevenage, England. Tests on sewage sludge have concentrated on economical methods of disposal, agricultural benefits, metal extraction, and pumping of thickened sludge with 12% solids contents. Oxygen injection into activated sludge plants and rising main sewers has been practiced as an alternative to diffused air and surface aeration. Anaerobic digestion rather than aerobic treatment has been tested as a source of methane production, as an economical means of treating warm waste water, and as a method which produces less sludge. Anaerobic filtration of acetic acid-bearing waste water has been found to reduce organics by 90-97%. Urban runoff measurement and sampling has been conducted in on-site investigations. The sensitivity of fish to pollutants, odors, and reduced dissolved oxygen concentrations has been measured using rainbow trout. Leaks have been detected in water pipes and pressurized sewage conduits with a sulfur hexafluoride injection technique. When a leak is present, the sulfur hexafluoride gas permeates to the ground surface and collects in bar holes drilled above the pipes.

J094
DEVELOPING NATIONS FACE PROBLEMS IN WATER AND WASTEWATER MANAGEMENT,

Larrick, C. L., and Adams, L. W.

Water and Sewage Works, Vol. 125, No. 6, p 62-63, June, 1978.

The past, present, and future status of water treatment and sewerage in developing countries is reviewed. Many developing nations are still serviced by pre-World War II water and waste water systems that are now inadequate for the population. The World Health Organization has financed feasibility studies for water and waste water management surveys in developing countries through the World Bank. Marginal progress has been achieved in urban centers within the past 10-15 yrs; sewerage systems are not often considered as important as a water supply system. Industrial development in emerging countries often occurs at the expense of sewerage systems and the environment; the governments and populations of developing countries should be made aware of the environmental impact of unrestricted industrial expansion. Water and waste water management and development are often not priorities in these countries. This has resulted in a large number of foreign-born engineers and scientists, trained in the United States and elsewhere, who do not have positions to return to in their own countries. There is also a lack of trained management, administrative, and operations and maintenance personnel for water quality management projects in these countries.

J095
HEALTH EFFECTS OF LAND APPLICATION OF WASTEWATER AND SLUDGE: WHAT ARE THE RISKS?,

Sorber, C. A., and Sagik, B. P.

Texas University,
San Antonio,
Center for Applied Research and Technology.

Water and Sewage Works, Vol. 125, No. 7, p 82-84, July, 1978. 3 tab, 5 ref.

The potential impact on public health of toxic materials and pathogenic organisms contained in waste water and sewage sludge applied to land was discussed at the 1977 Conference on Risk Assessment and Health Effects of Land Application of Municipal Wastewater and Sludge. Studies have concluded that pathogens can survive sewage treatment; pathogens isolated from sewage include salmonellae, shigellae, E. coli, enteric viruses, several species of protozoa, and a number of helminths. Transmission of disease from these pathogens by sewage applications to land, however, was considered unproven. Organic chemicals and metals present in primary sewage effluent were considered potential sources of groundwater contamination through toxin migration or seepage from land application sites. More research into the impact of these toxins on public health and their fate after land application of sewage was recommended. Another consideration in evaluating land application of wastes was the accuracy of epidemiological techniques to identify and quantify pathogens in waste water. Because of the nature of viral infection transmission, the source of a disease can be difficult to trace. The total removal of viruses from wastes was recommended before land application.

J096

HUGE LOANS FUND WORLD'S LARGEST SEWAGE WORKS,

World Water, Vol. 1, No. 1, p 11, May, 1978.

The world's largest sewage treatment plant, planned for Sao Paulo, Brazil, will serve a population of 5.5 million and extend sewerage to 55% of the city's 10.6 million inhabitants. The $1,240 million Sanegram project is being partially funded by the Sao Paulo Water and Sewerage Fund, the Banco Nacional de Habitacao, and by a loan for $110 million from the World Bank. The sewerage project will alleviate groundwater and surface water contamination. The sewer system will contain 5,500 km of collectors, 60 km of interceptors, and 10 pumping stations. The largest treatment plant will have a capacity of 63 cu m/sec; two major secondary and two smaller plants are also planned. Consulting engineers for the project are Metcalf and Eddy.

J097

STANDARD UNITS SOLVE SEWAGE TANK ACCESS PROBLEM,

Surveyor, Vol. 151, No. 4484, p 26, May, 1978.

Stephens and Carter of Brentford, Middlesex, England, custom designed an access walkway for the underground sewage balancing tanks at a treatment plant in Amersham, England. The underground basins, which are employed during peak and storm periods, require periodic cleaning. The four pentagonal tanks have bases which slope down to central channels; this configuration made access and footing difficult. The walkway is constructed of Climalloy components connected by aluminum sections. The access unit spans the central channel of the basin and is held in position by the counterbalance of the splayed castors at each corner; the unit is 3.05 m long, and 1.35 m wide. The span has aluminum decks which are adjustable up to maximum height of 2.76 m. The unit is mobile and can be used in all four balancing tanks.

J098

REGION OF DURHAM LEADS WAY WITH SLUDGE DISPOSAL,

Water Pollution Control, Vol. 116, No. 5, p 22, May-June, 1978.

A comprehensive study of sludge disposal techniques is planned for nine sewage treatment plants and six water treatment plants in the region of Durham, Ontario, Canada. The sewage treatment plants have capacities ranging over 0.4-15.0 mgd; the water treatment plants have capacities of 0.7-30.0 mgd. The study will investigate the current sludge handling and disposal techniques used in all the plants and the problems associated with sludge treatment. The nutrient concentrations and metal contents of the individual sludges produced by the treatment plants will be measured and the results compared to guidelines established by the Ministries of Agriculture and Food, Health and Environment. The final report will evaluate land disposal, landfilling, lagooning, and incineration as singular or combined methods of disposing of sludge from each plant.

INDICES

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